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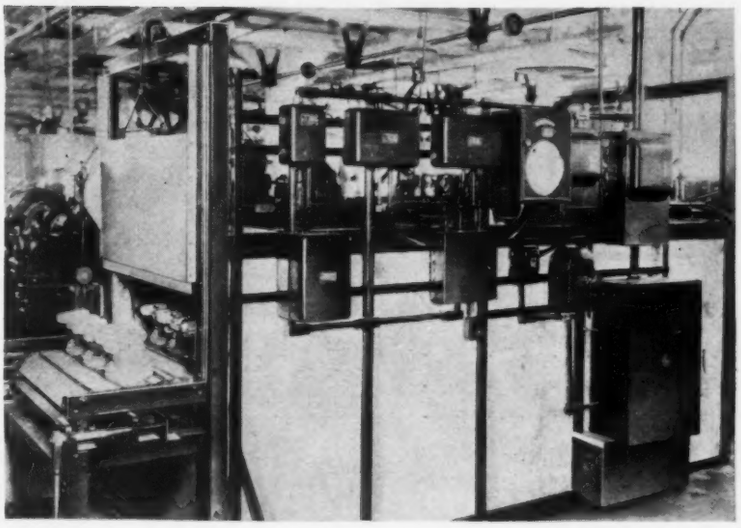

Full automatic oven control, cylinder head annealing, Wright Aeronautical Corporation

NOVEMBER 28, 1931

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ELECTRICAL WORLD

Established 1883. McGraw-Hill Publishing Company, Inc.

for the Week Ending

November 28, 1931

Transmutation of elements is no longer Utopian, but has become possible today within very restricted limits. Who knows where the future will take us?

GUGLIELMO MARCONI,
Scientist, Radio Pioneer.

Lost! $480,000,000 a year

—**How to reduce system losses** is a problem worthy of real analysis and effort. They are computed to represent some 20 per cent of total generation. Logical study is the first approach—*p. 948.*

—**Slag-tap furnaces economical,** is conclusion of Fuller-Lehigh men, who see savings in lower building costs and in better operating conditions. Labor also saved. Stack dust reduced too—*p. 958.*

Don't abandon the anti-trust laws

—**Beware far worse conditions,** is the admonition of "Wild Bill" Donovan, one-time Assistant Attorney-General of the United States, to those many eager seekers for revision of the Sherman anti-trust act—*p. 967.*

—**Do rural lines cost too much?** J. H. Matthews, chief engineer Illinois Commerce Commission, told an N.E.L.A. division meeting so and offered some cost comparisons to clinch his point—*pp. 952 and 946.*

—**Muscle Shoals report is made** and committee finally comes out for private operation on a non-profit or co-operative basis. Construction of Cove Creek Dam is recommended as essential—*p. 941.*

—**Lighting the modern theater** means co-ordination of effort to produce effects on and off the stage and to direct attention to spectacular elements. New York's newest playhouse has some startling tricks for jaded eyes—*p. 962.*

Pennsylvania electrification plans

—**New York-Washington in 1933** is the schedule for main-line electrified operation of the Pennsylvania Railroad. Train speeds will be increased and traveling time cut if plans carry through—*p. 938.*

—**Modernization cut fixed costs** in a chemical plant by reducing insurance premiums. Other benefits of rewiring and redesigning distribution facilities included lower energy losses—*p. 955.*

Light can decorate the theater

Main-Line Electrification in 1933 Is Aim of Pennsylvania Road

EXPECTATION that electrified operation of through freight and passenger service between New York and Washington will be begun in 1933 is expressed in the latest reports from J. V. B. Duer, electrical engineer for the Pennsylvania Railroad. Alternating-current electrification between the Sunnyside yard on the Long Island side of the East River at New York and Manhattan Transfer—junction point between New York and Newark, N. J.—is already about 95 per cent complete and will be ready some time after January 1 next. It will replace the present direct-current system in the Pennsylvania Terminal area.

Between Manhattan Transfer and New Brunswick, N. J., the electrification is approximately 50 per cent completed, and officials hope to have this section in operation in the summer of 1932. Between New Brunswick and Trenton work is actively under way on the foundations for the catenary structures and the preparation of the substation sites, and this length also should be complete for operation next summer. The link between Trenton and Philadelphia was completed in 1930, and the railroad expects, therefore, to run through trains from New York to Philadelphia in 1932. Electrified commuter service between Philadelphia and Trenton is already in operation.

Between Philadelphia and Wilmington also the line has already been electrified, and between Wilmington and Washington work is actively under way on the installation of the foundations for the catenary structures and the construction of the duct line in which communication and signal circuits to prepare for the electrification work will be placed. The link between Wilmington and Washington, the last section of the project, will, it is expected, be completed in 1933, bringing with it the continuous main-line electrification from New York to Washington.

After the electrification is completed between New York and Washington in 1933 there will be 2,210 miles of electrified track; 99 substations, with an installed capacity of 1,374,500 kw.; 1,681 miles of single-circuit transmission line and 1,686 miles of catenary circuit. Use will be made of 136 passenger electric locomotives, 86 freight electric locomotives, 98 switching electric locomotives and 1,637 multiple-unit cars. Operation will require 1,185,000,000 kw.-hr. a year.

▼

Ohio Power Company to Cut Rates $1,000,000

A SAVING OF $1,000,000 a year to 200,000 customers is predicted from the voluntary reductions in residential, commercial, industrial and rural rates included in a new tariff schedule of the Ohio Power Company, approved last week by the Ohio Public Utilities Commission and to become operative December 1.

The old rate for residential consumers was 7½ cents a kilowatt-hour for the first 30 kw.-hr., 6 cents for the next 30, 5 cents for the next 40 and 4 cents for all over the first 100. The new rate is 7 cents for the first 30 kw.-hr., 4 cents for the next 40, 3 cents for the next 230 and 2 cents for all over the first 300 kw.-hr. The minimum charge to residential consumers is reduced from $1 to 51 cents monthly and penalties for delayed payment are cut from 0.5 cent a kilowatt-hour to 5 per cent of the total bill.

The Ohio Power Company operates in ten divisions, with respective headquarters in Canton, Lima, Tiffin, Van Wert, Steubenville, East Liverpool, Coshocton, Newark, Wheeling, W. Va., and Portsmouth.

▼

Westchester (N. Y.) Utility Offers Cut of $1,000,000

NEGOTIATIONS OVER THE long-agitated rates of the Westchester Lighting Company in the populous suburban-city territory just north of New York City and the northerly part of Bronx Borough in that city finally brought this week a proposed schedule from the company which its officials and Chairman Maltbie of the commission say will cut the existing scale from 20 to 33 per cent and bring customers, residential and commercial, a saving of $875,000 a year, besides $125,000 in reductions for street lighting. The agitation, led by New Rochelle, had been for a 28 per cent cut.

The proposed residential schedule calls for a charge of $1 for the first 5 kw.-hr., 7 cents a kilowatt-hour for the next 20 kw.-hr., 6½ cents for the next 175, and 5 cents for all energy in excess of 200 kw.-hr.

The commission's announcement followed a conference in which company officials and counsel for the city and various Westchester communities participated. The hearing was set for Tuesday, December 1.

▼

Harding Street Plant Ready at Indianapolis

VISITORS WERE WELCOMED on November 23 to the new 73,500-kw. Harding Street generating station at Indianapolis, which will soon be placed in operation to serve the city and Marion County. At the same time the new 50-mile, 132-kv. transmission line, which makes a complete circuit around the

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COMMONWEALTH EDISON VETERANS FORGATHER

John F. Gilchrist (left), 43 years with the company, and E. W. Lloyd (right), with 33 years, add their combined record to that of O. R. Hogue (center) to make a total of 111. The occasion is a dinner at Chicago celebrating Mr. Hogue's thirty-fifth anniversary with the company.

city, tying in all the main feed lines, will be placed in operation.

The Harding Street plant is about 4 miles south of the center of Indianapolis, on White River, which insures ample water for boiler and circulating purposes at all times, and every modern device known to efficient steam-electric generation has been included. Provision has been made for future growth to double its present capacity, making the ultimate installation four units of 35,000 kw. each, with four house auxiliary generators of 1,750 kw. each.

▼

Radio via Power Lines Planned for Cleveland?

WIRED RADIO, whereby radio broadcasting is conducted over the power company's distribution circuits and received by the subscriber from any outlet, attracted renewed interest from a statement made last week by Major General George O. Squier, retired, before the National Academy of Sciences at Yale University.

"Today, after nine years," said General Squier, referring to the first demonstration of his "wired wireless," or "Neonphone," on March 24, 1922, I have to report a practical development extending continuously throughout this period at a cost of about $3,000,000 and in which at present a staff of 75 men is employed in the laboratory at Ampere, N. J. Superimposed upon the 60-cycle power transmission plant without interference is a 13-kilocyle carrier current which is stepped up in multiples of the lucky number 13 to deliver three separate programs simultaneously into the homes of subscribers from the standard light socket on frequencies of 26, 39 and 52 kilocycles per second. The complete equipment, designed, manufactured and tested for 270,000 homes, is now ready for shipment to Cleveland."

▼

Missouri City Plants Not Under Commission Rule

A DECISION JUST MADE by the Missouri Supreme Court declares that the Public Service Commission has no jurisdiction over the rates and practices of municipally owned public utilities, declaring unconstitutional that section of the Public Service Commission act which subjected such plants to control by the commission. The decision was in connection with injunction proceedings brought by the city of Columbia to restrain the commission from proceeding with an audit and appraisal of the Columbia municipal light plant with the intention of fixing a rate base and determining the reasonableness of the rates charged by the city. The test case was instituted in April, 1930, when residents of Columbia filed a complaint with the commission against the rates charged.

The court holds that omission from the title of the act, which was passed in 1913, of any mention that regulation of municipal utilities was one of its purposes invalidates it because of a requirement in the state constitution that the objects of a legislative act must be clearly expressed in the title.

▼

Oregon's Commissioner Gives Views on Two Points

IN RESPONSE TO A REQUEST for his informal opinion as to the merits of gross revenue taxation applicable to public utilities, Utility Commissioner Thomas of Oregon advised municipal councilmen of Salem that any such special tax levied against the public service corporations would automatically render it mandatory on the part of his office to grant an increase in rates upon application of the operators thus affected.

In another communication, addressed to Lakeview citizens, Mr. Thomas announced that his department will not lend its sanction to ordinances or other municipal undertakings designed to regulate public utilities, and that although a 1931 legislative act does authorize incorporated cities and towns to exercise regulatory powers, the same law does not require that the Utility Commissioner give official approval to the municipal measures enacted for the purpose, this being a matter for the exclusive consideration of city attorneys and municipal authorities in general. The only concern of his office, Mr. Thomas said, lies in determining whether or not the best interests of the public will be served by such regulation.

▼

Ottawa River Rights Go to Gatineau Power Company

A PRELIMINARY STEP toward further extensive power development on the Ottawa River, below Lake Temiskaming, was taken recently when the Province of Quebec authorized the Minister of Lands and Forests to accord to the Gatineau Power Company control of the river from the Temiskaming Dam down to Allumette Lake, a distance of 80 miles, subject to ratification by the Province of Quebec, the Dominion government, the Ontario Hydro-Electric Power Commission and the Gatineau Power Company.

The Ottawa River between the points mentioned is an interprovincial stream forming the boundary between Quebec and Ontario. The Quebec government's action relates to that half of the power potentialities which is in Quebec. Development of the power sites would have to be arranged with the Ontario Hydro Commission representing Ontario. Conditions attaching to the issue of rights include rebuilding of the Temiskaming Dam by the Gatineau company with the consent of the Ottawa government, preservation of the flow of the river to existing leaseholds on the river below and certain rights to be accorded the Ontario Hydro. The power potentialities awarded are understood to total 300,000 hp. or more.

"LIGHT WILL REPAY THE WRONGS OF NIGHT"

—Courtesy Curtis Lighting, Inc.

When Francis Quarles, seventeenth-century minor poet, wrote the above line he did not see this picture of seven 200-watt fly lamps and twelve 150-watt footlamps illuminating every detail in the appearance of prisoners standing in the "show-up" room of a Sioux City (Iowa) police station while complainants invisible to them sought to identify them.

▼ ▼ ▼

Central-Station Practice Gives Topics to Coal Men

No fewer than 1,225 registrants, representing a score of countries, attended the sessions of the third International Conference on Bituminous Coal at Pittsburgh last week, of which the opening was noted in the Electrical World for November 21 (page 895).

Among the many aspects of the coal industry which came in for comprehensive discussion were some of direct interest to the electric light and power utilities. Carbonization was one of these, and 39 papers were read dealing with this process both at high and low temperatures and with the extraction and recovery of by-products.

Abatement of smoke and dust was very properly accorded a place on the program. In relating what is being done in England, Prof. C. H. Desch told of the distinction there being made between preventable and unpreventable smoke. Steam-boiler and heating furnaces, as well as certain industrial operations, fall within the former class, to which stringent measures are being applied. Other industrial processes, including metallurgical furnaces and Bessemer converters, fall within the second class.

Complete elimination of smoke was the goal advocated by Hector J. Azbe of St. Louis. Difficulties and problems in achieving this end were discussed by Ely C. Hutchinson, editor of *Power;* A. W. Bailey of the Commonwealth Edison Company and George A. Orrok of New York.

In a paper describing the operation of large stoker-fired furnaces under suction rather than with balanced draft, Bert Houghton, operating superintendent Brooklyn Edison Company, also introduced some interesting data concerning the operation of stokers in general. Orsat analysis of the products of combustion is the usual means of combustion control, either directly or as a basis for calibration of meters and regulators. Complete analysis of the gases, however, indicates that the Orsat analysis tells only part of the story. Curves shown by Mr. Houghton show that a difference in the extent of measured losses may exist between the two methods amounting to as much as 3 to 10 per cent. This difference, representing the hydrogen and hydrocarbon losses, usually appears in the unaccounted-for section of the heat balance. Stress was placed by Mr. Houghton on the importance of careful training of the stoker operator and the necessity of insuring that both boiler meters and combustion control apparatus be synchronized by careful calibration throughout their entire range.

What Germany is doing in the transportation of pulverized coal in pipe lines and cars was described by Friedrich Schulte, director of the Association of the Power Industry of the Ruhr District. There such pipe-line transportation is done exclusively by pneumatic methods. Suction operation is employed for distances up to 450 yards and pressure operation up to 2,000 yards. For greater distances intermediate stations are employed and in some cases both pressure and suction are used. Where pulverized coal is to be transported considerable distances tank cars are employed.

A paper by E. G. Bailey and R. M. Hardgrove discussed the slag-top furnace and its effect upon the selection of coal for burning in pulverized form. The authors included a table giving details of 67 such installations, comprising a total boiler capacity of 22,592,000 lb. of steam per hour, and contended that this type of furnace is applicable to all coals having an ash-fusing temperature below 2,500 deg. F. With coals having higher ash-fusing temperatures it is possible to use fluxes such as will scale or soda ash to make the ash fluid.

E. H. Tenney, chief engineer Union Electric Light & Power Company, St. Louis, reviewed some of the theoretical and laboratory investigations of pulverized-coal burning and attempted to co-ordinate these with the results attained in actual practice in firing low-grade bituminous coal.

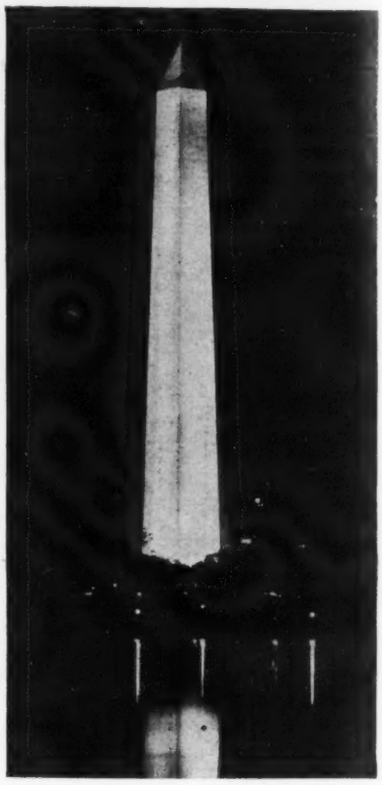
Progress with the Rupa motor (coal-dust engine) was reported in a paper by Rudolf Pawlikowski presented by Prof. Willibald Trinks. The seventh engine of this type to be constructed has run nearly 1,000 hours in continuous operation with an average load of about 130 hp. in addition to numerous test runs of ten to fourteen hours daily.

▼

A. E. C. Committees Work for Engineers' Employment

State committees on "engineers and employment" are now at work under the auspices of the American Engineering Council in 23 of the commonwealths and in the District of Columbia. Their activities fall into two classifications—"emergency plan" and "future plan." Under the first category fall efforts, in co-operation with other agencies, to list governmental works authorized, determine their status and accelerate them where possible, and also efforts to canvass opportunities for public engineering work of every kind throughout the country, to expedite such undertakings and provide the means to get them under way. The second category is concerned with sweeping plans for the better organization of means to meet the public, recreative and employment needs of the American people.

WASHINGTON MONUMENT AT LAST ILLUMINATED



—*Wide World Photos*

View from across the Tidal Basin. Monument is no longer a peril to aviators at night.

▼

Service Charge Versus Minimum Monthly Rate

In fixing rates for the municipal electric plant of New London, Wis., recently, the Wisconsin Railroad Commission took occasion to say that a rate schedule which provides for a monthly service charge to be paid irrespective of whether or not a consumer uses any energy is a more scientific rate, at least in so far as residential and commercial lighting service is concerned, than the minimum monthly bill under which some energy may be used. This opinion, *Public Utilities Fortnightly* points out, differs directly from that taken by the New York Public Service Commission and other state regulatory bodies.

The Wisconsin commission holds that a minimum monthly bill for electrical service is discriminatory in that those customers who use the maximum amount of energy allowed under the minimum bill do not pay their proportionate share of the cost of service as compared with those who consume little or nothing or those who consume energy in excess of the minimum bill.

Fertilizer Production Is Burden of Muscle Shoals Report

NOTWITHSTANDING an adverse report from the chief of the federal Bureau of Chemistry and Soils, concurred in by Secretary of Agriculture Hyde, as to the necessity of the government plants at Muscle Shoals for the production of ammunition or their desirability for synthetic manufacture of nitrogen and his hesitant approval of the conversion of equipment to produce phosphoric acid, the report of the Muscle Shoals Commission to President Hoover, rendered last week, concludes that:

It is economically feasible and desirable to use and operate the Muscle Shoals properties for the following purposes:

(a) Primarily for quantity production of types of commercial fertilizer and/or fertilizer ingredients of greater concentration than those which are now generally sold to the farmer.

(b) Co-operative scientific research and experimentation for the betterment of agriculture.

(c) Manufacture of chemicals.

The report continues: "It is the definite conclusion of the commission that the foregoing public benefits can best be obtained by private operation under lease contracts through competitive negotiations."

In accordance with these findings the nine members—three appointed by President Hoover, three by the Governor of Alabama and three by the Governor of Tennessee—unanimously recommend the enactment of the necessary enabling legislation by Congress empowering the President or such agency as he may elect to conclude a 50-year lease contract at "a fair and reasonable rental" for the United States properties at Muscle Shoals, and to supervise operations thereunder for and on behalf of the United States, the lease to give effect to the plans for fertilizer and chemical manufacture just quoted. Construction of the Cove Creek Dam and of an equalization dam below Wilson Dam is also recommended. Further, the report says:

In behalf of the development of the Tennessee Valley, there should be authority to sell or use surplus Muscle Shoals property and to sell or dispose of, on an equitable basis, surplus power at the switchboard, states, counties, municipalities and chemical operations to have preference. The remainder of such surplus power shall be subject to recall on reasonable notice for the purpose above named.

The report then recommends apportionment of rentals and other receipts so as to promote agricultural research and fertilizer manufacture.

Preference as a lessee, the commission declares, should be accorded a corporation exclusively owned and controlled by organizations of farmers, operated without profit. The commission expresses its belief in the ready negotiability of such a contract as it advocates and in its "immeasurable" benefits to agriculture. It discloses that none of eight offers for private operation received by it in response to advertisement was found satisfactory.

With its own report the commission transmitted a report by Lieut.-Colonel M. C. Tyler on the cost to the government of transmitting and selling Muscle Shoals power. In his conclusions Colonel Tyler says that the existing government power plants and the proposed Cove Creek development are not suitably located to serve as the main generating stations of an extensive independent power system; that the construction of an independent system would involve large expenditures of public funds; that the cost of transmitting power in such a system would be high and reliability of service at long distances from the generating center would be poor; that the construction of such an independent system would be an economic waste in that it would duplicate transmission facilities now ample to serve the region, and that it might be expected that the deficit from the construction and operation of such a system, which would have to be met by the federal treasury and by the general taxpayers, would largely exceed any savings from lower rates which might accrue to the limited local public served.

President Hoover will submit the commission's report to Congress. Senator Norris, author of the bills for government operation vetoed by Coolidge and Hoover, lost no time in condemning it. He said: "We would have a great development, paid for out of the people's money, manufactured from a raw product owned by the people, and yet with the impossibility of the people ever getting it unless they paid tribute to the power trust."

▼

Coming Annual Winter Meeting of A.S.M.E.

BUSINESS STABILIZATION will be one of the non-technical subjects to which the American Society of Mechanical Engineers will address itself in the course of its annual meeting in New York

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LITTLE SAVE FOUNDATIONS OF ORIGINAL (1903) PLANT REMAINS

Entirely rebuilt and modernized at a cost of $1,250,000, the Lynchburg (Va.) hydro plant of the Appalachian Electric Power Company, at Reusens, 4 miles from the city, now possesses five 2,500-kw. vertical generators, which feed the company's 132-kv. transmission system. The plant is able to carry Lynchburg's peak load for eight hours without river flow, and much longer when the flow is normal.

from November 30 to December 4. Virgil Jordan will discuss it from the economical, James W. Hook from the industrial and Paul M. Majur from the financial point of view. Dr. S. Marion Tucker will talk on public speaking, and Frances Perkins, Industrial Commissioner of New York State, on accident prevention through co-operation with engineers.

At the central-station power session on December 3 there will be three papers: "Solubility of Calcium Salts in Boiler Water," by Frederick G. Straub; "Performance of Modern Steam-Generating Units," by C. F. Hirshfeld and G. U. Moran, and "Influence of Inlet Boxes on the Performance of Induced-Draft Fans," by Lionel S. Marks and E. A. Winzenburger. Other sessions will be concerned with industrial power, fuels, hydraulics, feed water and cognate subjects.

▼

Spectacular Lighting for Kansas City P. & L.

ESPECIALLY ELABORATE plans have been made to floodlight the new office building of the Kansas City Power & Light Company, the highest in Kansas City, into which the company moved this month, just 50 years after the company's predecessor had signed what is said to have been the first contract in America for the commercial exploitation of energy. The building (illustrated in the ELECTRICAL WORLD for December 27, 1930, page 1161), from its base at the Fourteenth Street and Baltimore Avenue sidewalk to its apex, is 478½ ft. high, the first thirty stories being surmounted by an ornamental tower which represents about one-fifth of the total height of the structure.

The plan is to make the building a pillar of white from the ground to the thirtieth floor and then to top this pillar with a blaze of colored light—white, green, amber and ruby—issuing from four large windows of prismatic glass and shed from outside by searchlamps. In the exterior lighting system a battery of 434 floodlighting units will be used. They will be divided between 500-watt and 1,000-watt lamps. The total connected load will be 245 kw. in white lights and 125 kw. in colored lights. When the floodlights are not in use a beacon of red light will crown the structure, for the guidance of aviators, this being provided by neon tubes operated by a solar switch.

On the fourteenth floor of the 40-story structure will be the control room, where an elaborate system of "telltales" will register immediately trouble on any part of the distribution system. This is expected to expedite the correction of line and transformer difficulties. An auditorium on the fourth and fifth floors seating more than 1,000 is another feature.

CLOSE-UP OF DALLAS POWER & LIGHT BUILDING

Situated at Jackson and Browder Streets, Dallas, Tex., this new eighteen-story central-station office structure claims the distinction of being the tallest electrically welded building yet erected.

▼

Mississippi River Span at Memphis Completed

LINKING THE east and west banks of the Mississippi River and suspended from two massive towers just south of Memphis, a 4,300-ft., 110-kv. span, just completed at a cost of $400,000 by the Memphis Power & Light Company, now connects that company's transmission system with those of the Arkansas Power & Light Company, the Louisiana Power & Light Company and the New Orleans Public Service Company, in order to provide amply for exchange of power when the need arises. The towers, 435 ft. high and 90 ft. square at the base, are erected on eight concrete piers 128 ft. in depth. These piers are for all practical purposes equal to bridge piers, and should the fickle Mississippi change its course at some future date, the towers would continue to function.

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Scattered Happenings in the Electrical Sphere

UNITED STATES

Columbia Courses for Idle Engineers

Columbia University is helping to alleviate the situation and preserve the morale of unemployed engineers by permitting them to attend the regular classes in the engineering school. No fees will be charged or credits given, and the enrollment will be limited to the capacities of the lecture halls. Applicants must be certified as accredited members of the profession by the professional engineers' unemployment committee which is acting to find work for the large number of unemployed engineers in the metropolitan district.

Philadelphia Electric Merger Held Up

Refusal of permission to the Philadelphia Electric Company to purchase the Chester Valley Electric, Coatesville Electric Light, Heat & Power and Chester Valley Electric Light, Heat & Power companies has been announced by the Pennsylvania Public Service Commission, which says it would not

"be justified in withholding from the consumers in Coatesville, Downingtown and surrounding territory the lower rates which the Philadelphia Electric Company already has in contiguous territory."

Aftermath of Ousters in Missouri

The Missouri Supreme Court on November 17 ordered the enforcement of an ouster decree issued last April against the Electrical Listing Bureau of St. Louis, one of several electrical bodies found guilty of violating the state's anti-trust laws (ELECTRICAL WORLD, April 25, page 750). The decree had been suspended conditionally, but the bureau failed to comply with the conditions laid down by the court. The state charter of the bureau will be forfeited. The bureau abandoned its activities after the order of last April.

Another Rate Reduction for Tulsa

Further voluntary electric rate reductions applying to domestic consumers in Tulsa and seven nearby towns have been filed with the Corporation Commission by the Public Service Company of Oklahoma. The rate in Tulsa was cut from 8 to 7 cents a kilowatt-hour for the first 50 kw.-hr. Total savings by the new cuts are put at $110,000 annually.

Augusta, Ga., Declines Offer of Utility

Refusal is reported of the offer made by the Georgia Power Company, as noted on November 14, page 855, to purchase excess power from the municipal electric plant to be built on the Augusta Canal, if Augusta would not compete with the company but confine itself to lighting the city and supplying the industrial plants on the canal. The Augusta Canal Commission, which is in charge of the project, has determined to build a Diesel engine plant first, to be used as a standby plant in the completed system, and later to construct a hydro-electric plant on the canal. A bond issue of $2,500,000 was authorized by the City Council by a vote of fourteen to two.

More Utility Legislation in Wisconsin?

To a special session of the Wisconsin Legislature which assembled on November 24 to consider unemployment relief and other matters Governor P. F. La Follette has proposed revision of the public utility statutes adopted at the regular session of 1931 and now under attack in the courts.

Faraday Again Commemorated

A score or so of the most prominent men in the electrical industry were among the audience which gathered on the evening of November 18 at the Engineering Societies Building in New York, under the auspices of the New York Museum of Science and Industry, to celebrate the centenary of Michael Faraday's discovery of electromagnetic induction. Dr. Elihu Thomson made the chief address. Prof. Dugald C. Jackson of the Massachusetts Institute of Technology sketched the technical progress of the last hundred years. Dr. F. B. Jewett presided.

Overhead Lines in Westchester Opposed

Opposition has arisen in Westchester County, N. Y., to the construction of overhead high-tension transmission lines as part of the projected interconnection of the Niagara-Hudson and New York Edison systems, on the ground that property values would be damaged.

Expansion of Richmond (Ind.) Plant

The municipal plant of Richmond, Ind., which is doubling its generating capacity at an approximate cost of $850,000, will also construct a three-circuit belt line about the city to insure at least a two-circuit service to all factories.

New Albany Residential Rates Lower

After two years of negotiation the Public Service Company of Indiana has made a prop al to the city administration of New Albany for a reduction in residential electric rates. The company estimates that the new schedule will mean an annual saving of $35,000 to residential consumers. Commercial and power rates will remain as before until an adjustment can be made by the Public Service Commission. In its first offer the company proposed to increase non-residential rates. That proposal was rejected by the city, which threatened to build a street-lighting and eventually a complete municipal plant.

Big Offer for Shelby (N. C.) Plant

An offer of $1,000,000 from the Southern Public Utilities Company of Charlotte for the Shelby (N. C.) municipal light plant is reported. Approval by a vote of the citizens is necessary to the acceptance of the offer. Shelby has about 11,000 population.

Coming Meetings

American Society of Mechanical Engineers—New York, Nov. 30-Dec. 4. C. W. Rice, 29 W. 39th St., New York

Pacific Coast Electrical Association—Engineering Section, Los Angeles, Dec. 9-11. K. I. Dazey, 447 Sutter St., San Francisco.

American Engineering Council—Washington, Jan. 14-16. L. W. Wallace, 744 Jackson Place, Washington, D. C.

American Institute of Electrical Engineers—Winter convention, New York, Jan. 25-29. F. R. Hutchinson, 33 West 39th St., New York.

North Central Electric Association—Commercial Section, Lowry Hotel, St. Paul, Jan. 29 and 30; Engineering Section, St. Paul Hotel, St. Paul, Feb. 22 and 23. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

National Electric Light Association—Group committee meetings: Engineering National Section, New York, Feb. 1-5; Accounting National Section, Statler Hotel, St. Louis, Feb. 15-17. A. J. Marshall, 420 Lexington Ave., New York.

More Rate Reductions in Kansas

The process of negotiated rate reduction in Kansas still continues, approval having recently been given by the Public Service Commission to a reduction of approximately 17 per cent in the domestic tariff in ten towns served by the Inland Utilities Company, with new monthly charges of $2.50 and $3 for 25 kw.-hr., and to a reduction from $3.75 to $2.50 for 25 kw.-hr. in two small communities supplied by the Utilities Service Company of Hoisington.

Dam on Texas Colorado Transferred

Formal transfer, in accordance with the original plans, has been made by the Emery, Peck & Rockwood Development Company of Chicago of its dam and 22,000-hp. hydro project on the Colorado River near Burnet, Tex., now under construction, and of the water rights and sites for other proposed dams and power plants on that stream between Austin and Llano, to the Central Texas Hydro-Electric Company, according to F. A. Dale, manager of the development company, who remains in charge. C. F. Boake of Chicago is president of the new operating company.

Drought in South Little Helped by Rain

Superficial relief from drought conditions in the Southeast was afforded by precipitation ranging from fairly heavy rains in the Lower Mississippi Valley to gentle showers east of the mountains, but in areas where there are large hydro developments no benefit resulted beyond a momentary checking of the drop in rate of stream flow. Reports from several sources state that power companies are increasing the use of their steam plants, anticipating further water shortages, since heavy rains usually do not begin until several weeks later in the season.

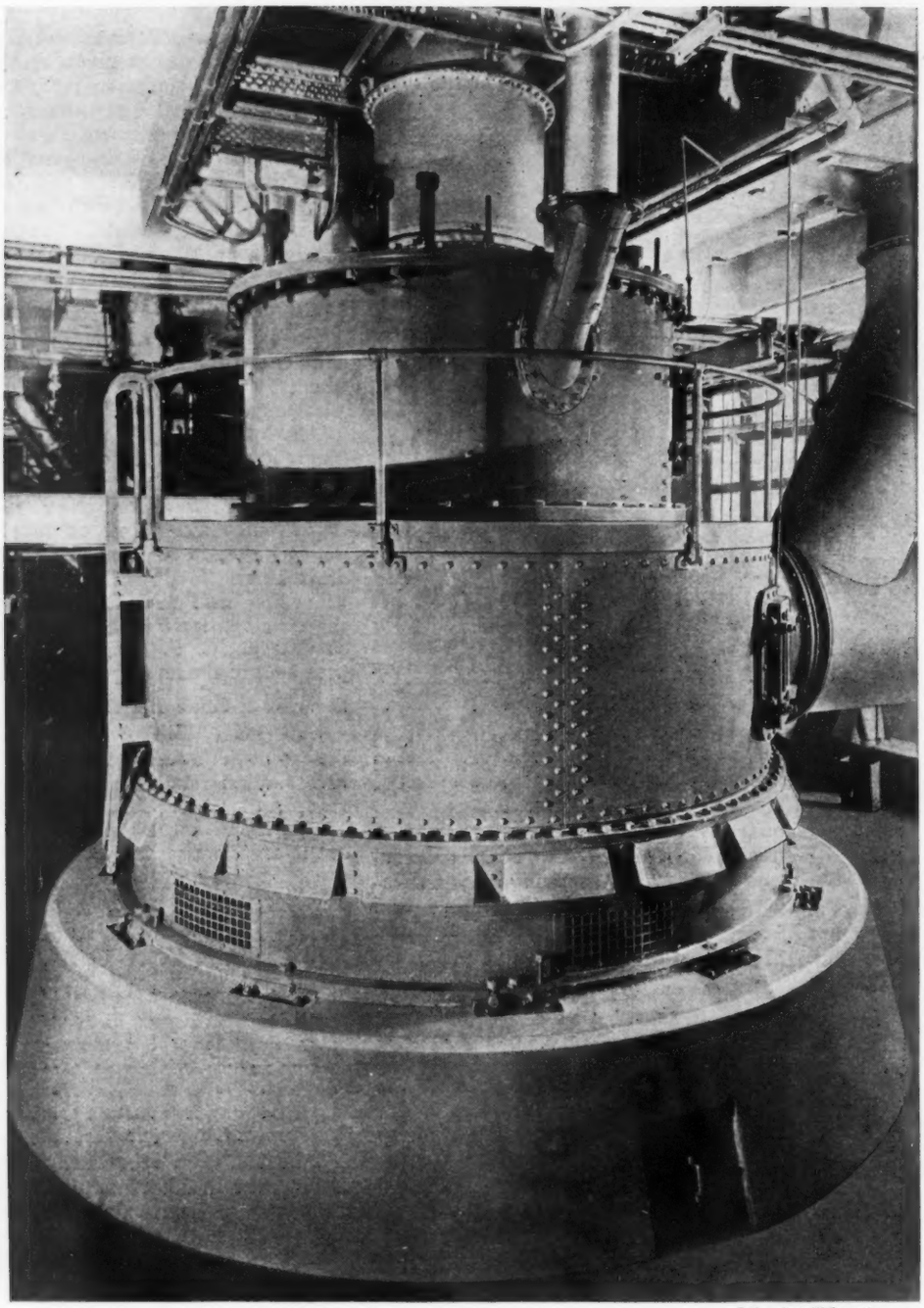
CANADA

Beauharnois Three-Quarters Completed

With full-scale operations under way all year, the Beauharnois power development on the St. Lawrence approaches the winter with three-quarters of its construction completed. Thus the work is still ahead of schedule. The power house was finished in October, when the roof went on the plant. The installation of the first two 50,000-hp. waterwheels has been completed, and the third and fourth turbines are now being installed. Installation of generators for these units is under way.

Manitoba Power Commission Appointed

A Manitoba Power Commission has been named by the provincial government, according to information from Trade Commissioner John A. Embry at Winnipeg. The officers are the Provincial Hydro Commissioner, chairman; the chief engineer of the Winnipeg Hydro, and the chairman of the city parks board.



Babcock & Wilcox Company

Pulverizes 50 tons per Hour

Until recently 25-ton pulverizing mills have been about the maximum size that utilities have been able to secure, or possibly even wanted. But the tendency to use single boilers and greatly increased rating per turbine and the necessity of keeping down the building space devoted to pulverizing units has compelled the consideration of larger units.

This mill, which is capable of pulverizing more than 50 tons of coal per hour, has been operating in the Kips Bay station of the New York Steam Corporation for about six months and was installed to conserve space and reduce operating and maintenance expense. It is driven by a direct-connected 500-hp. synchronous motor and occupies a floor space only 14½ ft. in diameter.

EDITORIALS

L.W.W.MORROW
Editor

Help established industry recover; let proselyting wait

SO COMPLETELY has the industrial picture changed in the last three years that a new type of task confronts the commercial departments of the utilities. Industry has been migrating steadily from the larger metropolitan centers to the medium-sized communities. All sorts of inducement have been added to clinch the decision when pure economics of accessibility to raw material and to markets did not, in conjunction with the labor-community advantages, provide an attractive appeal. Secretaries of industrial development commissions have more than done their jobs, and in this they have had the aid of the utilities. Now, however, the question is: What of existing industry that has no will to move except forward in its present location?

As many ways can be found by the power adviser to lend assistance to established industries as were developed for attracting new industries to a community. Knowledge of the demands for new products, knowledge of the availability of new industrial methods and practices, knowledge of the benefits of revamped plant layouts and power supply are peculiarly accessible to the utility power engineer. Such information should be passed on by him to local industry eager to resume its stride. Emphasis on the community benefits accruing from civic development, health, recreation, housing and street improvements will go far to supplant the artificial subsidies which have been extended in the past toward new industries. Such elevation of the civic tone will confirm the faith of existing industry in its chosen habitat and give it the courage to decline proselyting offers from other communities.

In one specific area the power sales expert can do much to cement the good will of the industrial units in the community. That is in connection with advice on rate options and rate changes. The moral burden is on the utility company to volunteer the application of the most advantageous of the new rates so frequently made available in the last few years. It is no burden at all to exercise at the same time the opportunity to discuss the manufacturer's problems with him as broadly as he is willing. This is especially true when shrunken demands and consumption are the rule. Stricken industry deserves this co-operation from the power company.

Muscle Shoals dedicated to agriculture

LAST week the Muscle Shoals Commission made its report to the President. It has built up a plan for the project that would dedicate it to the benefit of agriculture. It stresses private operation of the plants, preferably by a farmer corporation. It considers it feasible and economical to operate the properties primarily for the production of concentrated fertilizer and secondarily for agricultural research and the manufacture of chemicals. It agrees with the report of Lieut.-Colonel M. C. Tyler that it would be uneconomical to operate the plants as a government undertaking for the generation and distribution of power. Major Tyler clearly points out that from 1932 to 1946 the government, if it tried to enter the power business, would face a deficit of $39,674,000 with a saving to customers of only $17,917,000.

But the conclusion of the commission that the project must be dedicated to fertilizer and chemi-

cal manufacture is of doubtful economic validity in the face of the report of the Secretary of Agriculture and his experts. They state that the greatly reduced price of fertilizers, the development of new processes and the reluctance of the farmers to employ concentrated fertilizers make such a use of Muscle Shoals of questionable value. Especially pertinent is the comment that the making of phosphoric acid by electric furnaces is not competitive as a straight fertilizer enterprise. The commission seems to have been convinced of the desirability of this method.

Thus when the contradictory elements of the report are weighed in the balance with the political furor sure to be aroused by the advocates of governmental operation it is quite evident that the status of Muscle Shoals is and will be unchanged. It will continue to rust while statesmen talk about its disposition.

A major event in welding

PUBLICATION of the report of the structural-steel welding committee of the American Bureau of Welding marks a notable engineering achievement. At the recent National Metal Congress in Boston high authorities in the steel-making world paid tribute to the value of this investigation, which extended through five years and which was shared by three steel mills, thirty-nine fabricating shops, sixty-one welders, eighteen inspectors and twenty-four testing laboratories. The principal objective was the determination of safe-design values under static loading for various types of fusion-welded joints as commercially welded in fabricating shops and the degree of uniformity of the strength of welded joints that may be expected from such shops throughout the country. The tests included 1,098 specimens in connection with the qualifications of welders and 1,395 specimens in connection with the investigation proper—the latter involving fifty-five elemental forms of joint in 169 sizes.

In completeness of data the report is unusual, and it offers the structural designer valuable confirmation of the safety of stresses in accepted use, emphasizes the vital importance of severe qualifications for welding operators and shows that reasonably uniform results can be expected from any first-class fabrication shop. These points are of immense significance in the movement toward the wider acceptance of both electric and gas welding by code regulatory bodies, architects and structural engineers. The report adds a working tool of great value to the "kit" of the structural specialists and places the art—which it still is—on a conventional basis sure to redound to the benefit of the building and electrical industries.

Diversity of rural line costs no proof of extravagance

SOME rather critical comments on rural line costs made by the chief engineer of the Illinois Commerce Commission are presented in this issue, not because we agree wholly with what he says regarding the lack of rhyme or reason for differences in unit cost, but because the conclusions he intersperses or allows to be inferred are certain to be reached by others unless tangible examples are given to show how differences in conditions can alter unit figures.

It is futile to judge the relative values of different types of line construction from costs per mile alone. Even though all companies confined their rural construction to the same voltage, size of conductors, poles, cross-arms, insulators, spans, and so forth, and had the same labor costs, the costs per mile would still be dependent on the number of corners, one-way and two-way taps, dead-ends, step-down substations and railroad crossings and the method of handling services. Number and size of transformers would alter costs; character of soil would affect pole-setting expense; proximity of trees would influence construction or trimming costs; terrain would be a factor in span or pole construction and consequently in the cost of supports, and accessibility of the right-of-way for delivery of construction material and methods of erection would both play a part.

Now, if all these and other service conditions affect unit cost, differences in the voltages, spans and character of supports would add to the discrepancy. Yet who can say these differences in practice are not justified? Some companies have started with low-voltage, single-phase primary circuits. These may be satisfactory under the right conditions, but there are rural districts

where the character of load has warranted higher-voltage, three-phase primaries either because of load conditions or because of the possibility that the line may some day be a major artery.

Even though each company can justify its unit costs, however, line engineers ought not to be satisfied with the differences that are apparent until some way of comparing costs that will permit selection of the most economical construction, viewed with the future in mind, shall have been established.

A modern miracle: salt water to fresh by electrolysis

WHY, asked Jean Billiter, in a paper presented before the Electrochemical Society recently, in order to purify water must we convert the entire mass into steam and then condense it to liquid water? The amount of dissolved substances is usually very small—in most cases only 0.2 to 1 per cent of water and seldom more than 1 per cent—so why not carry out the purification by removing the small quantity of dissolved substances without touching the large mass of water? Upon such simple questions as this have whole scientific revolutions taken place.

A new one-compartment cell permitting the direct electrolysis of water with but little electro-osmotic effect has been built. Water with 150 to 600 mg./L of salt and even more can be readily purified, the product analyzing 6 to 9 mg./L salt. The new cell embodies two diaphragms, one of ceramic material and the other of asbestos. According to Professor Billiter, in spite of the relatively low energy efficiencies involved, it has been possible to apply the cells commercially to the purification of waters of normal salt content, the cost of purifying being lower than the cost of distilling the water and the product purer. Furthermore, the cost of the cells has not been higher—in many cases it has been lower—than the cost of distilling apparatus.

Is it too soon to anticipate the securing of pure drinking water from the sea? Cannot ocean liners benefit by the use for feed water of the compact and efficient electrolytic cells rather than depend upon the indirect process of distillation which is utilized in some instances or on large storage supplies as in others? Perhaps Mr. Billiter has offered electrical engineers a new load for technical refinement and commercial development.

Railroad routes for utility system facilities

OVERHEAD-WIRE lines, duct lines, pipe lines and railroad rights-of-way are all merely means of distributing a commodity or a service. They have that much in common, no matter how diverse their character or ownership, and the degree of resemblance should lead to a more extensive resort to the use of one route for several of these utility facilities.

Railroads have always been jealous of their domain and their prerogatives. Mass transportation of human beings with lives at stake is admittedly something to be taken solemnly. Sagging wires, high-voltage hazards, risk of interference with signal and communication systems, hazards created by construction and maintenance operations are serious obstacles to the promiscuous entry of other facilities on railroad rights-of-way. There has, however, been much progress made in composing the differences between railroads and power transmission companies as to wire crossings and parallels. Some of this progress can well be extended to cover an increased degree of common use of the continuous railroad routes by facilities of other companies.

The railroads need the money and, in the case of many lines, no longer require the exclusive use of their strip of land. The utilities in growing measure need such routes for their systems. The dollar "urge" is present on both sides, and to promote the economic advantage is only a matter of development of the joint-use technique that is required.

The railroads have suffered from the development of our amazing highway systems. They have however a highway system of their own the full potentialities of which have not been realized. One profitable use is manifestly the lease or easement of appropriate portions of this land to utility distribution systems in conjunction with adequate contractual safeguards against such hazards to life and limb as may be entailed in the process.

System Losses— Their Analysis and Reduction

By M. M. KOCH*

Superintendent Electric Distribution
Public Service Company of Colorado, Denver

With system losses amounting on the average to 20 per cent or more, entailing a loss to power companies of $480,000,000 a year, what more profitable field lies ahead of the engineer than recovery of at least part of this tremendous loss. An authority on this subject here outlines step by step the procedure to be followed in analyzing system losses, and suggests methods of reducing them.

CONSIDERABLE study has been given to developing plants or putting them on an efficient production basis, but has enough consideration been devoted to our commodity after it has been manufactured? Because this commodity has been reckoned in kilowatt-hours, something intangible, we seem to lose sight of its value. We expect to find a difference between production and recovery, but just how much of this difference is justified, or legitimate, and how much is unwarranted, or illegitimate, cannot be told until a careful study is made of each system.

In order to determine the losses in the various parts of the system a kilowatt-hour balance sheet and analysis should be developed (see the accompanying tabulations). The losses should be divided into three general classes, transmission, conversion and distribution. The distribution losses should be further subdivided, according to the districts in which they occur. Analyses by distribution circuits cannot often be made, but if it be possible to do so, bad recovery conditions can frequently be brought to light.

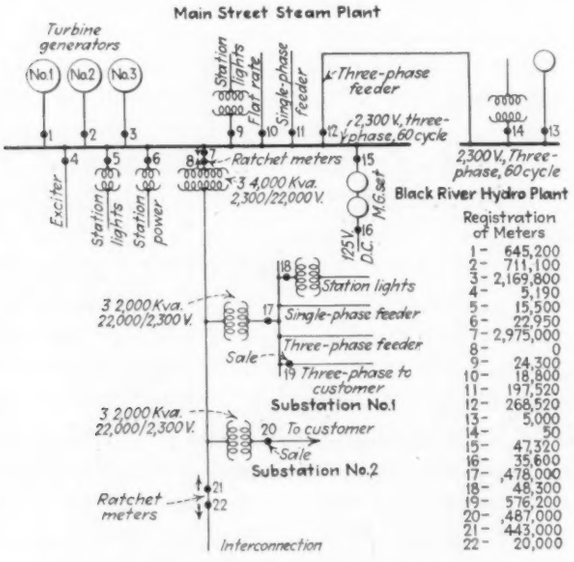
Meters should be placed throughout the system so that the inputs and outputs of transmission, conversion and distribution can be properly determined. The use of a one-line diagram, such as that here reproduced, showing the location of all watt-hour meters except, of course, individual customers' meters, and the electrical relation of each piece of apparatus in the system, is very convenient for making the analysis and, in complex systems, quite necessary. Referring to this chart, it will briefly be shown how such an analysis is made.

First, the "gross generation" of the system is determined, and, by subtracting the energy used in the plants for production purposes, the "net station generation" is obtained. To this is added any purchased power and is called the total "net station output."

Transmission Loss—Next, the "input to transmission" and the "output from transmission" are determined, and from these items the "transmission loss." Having obtained the transmission loss, it can further be subdivided into "high-tension iron loss," a figure calculated from the manufacturer's guarantee of core loss of the high-tension transformers, and the hours such were in service, and "transmission copper loss," which is obtained by subtracting the iron loss from the total transmission loss.

These losses are expressed as a percentage of the energy transmitted and can be compared from month to month. It is possible to justify a certain percentage of the copper loss, knowing the physical and operating conditions, and the balance is, therefore, illegitimate loss.

*Part of paper presented before Rocky Mountain Division, N.E.L.A., Estes Park, Colo.



One-line diagram of system metering aids loss analysis

GENERATION & OUTPUT DATA

		Main St. Steam PLANT A	Black Riv. Hydro PLANT B	PLANT C	PLANT D	TOTAL E
1.	No. 1 Generator A. C.	645200	5000			*
2	No. 2 Generator A. C.	711100				*
3	No. 3 Generator A. C.	2169800				*
4	No. 4 Generator A. C.					*
5	No. 5 Generator A. C.					*
6	Gross A. C. Generation	3526100	5000			3531100
7	Input to Exciters	5190				5190
8	Station Power	22950				22950
9	Station Lighting	15500	50			15550
10	Total Auxiliaries	43640	50			43690
11	Net A. C. Generation	3482160	4950			3487410
12	No. 1 Generator D. C.					*
13	No. 2 Generator D. C.					*
14	Gross D. C. Generation					
15	D. C. Auxiliaries					
16.	Net D. C. Generation					
17	Net Station Generation	3482160	4950			3487410
18	Purchased A. C.	*	*	*	*	143000
19	Purchased D. C.	*	*	*	*	
20	Total Purchased Power	*	*	*	*	143000
21	Net Station Output	*	*	*	*	3930410

GENERATION DATA

		STEAM A	HYDRAULIC B	GAS C	TOTAL D
22	Gross Generation	3526100	5000		3531100
23	Auxiliaries	43640	50		43690
24	Net Generation	3482160	4950		3487410

ANALYSIS OF LOSSES

		ACTUAL A	% B	% C	KOGIE D	% E	% F	EXCESS G
25	Net Station Output	3930410	100.00	*	3930410	100.00	*	
26	Input to Transmission	3418000	*	100.00	3418000	*	100.00	
27	Output from Transmission	2985000	*	87.33		*		
28	Transmission Loss	433000	11.01	12.67	329995		9.66	103005
29	H.T. Transf. Iron Loss	90735	*	2.66	90735	*	2.66	
30	Transm. Copper Loss	342265	*	10.01	239260	*	7.00	
31	Input to Conversion Involv. Loss	47320	*	100.00	47320	*	100.00	
32	Output from Conversion	35600	*	75.20		*		
33	Conversion Loss	11720	.30	24.80	11720		24.80	
34	Input to Distribution Involv. Loss	1311090	*	100.00	1311090	*	100.00	
35	Recov. of Input to Dist. Involv. Loss	1061210	*	82.47		*		
36	Distribution Loss	229880	5.85	17.53	129450		9.88	100430
37	Distribution Transf. Iron Loss	28518	*	2.18	28518	*	2.18	
38	Meter Shunt Loss	9156	*	.70	9156	*	.70	
39	All other Distribution Loss	192206	*	14.65	91776	*	7.00	
40	Total Loss	671600	17.16	*	471165	11.99	*	203435

ANALYSIS OF SALES & LOSSES

		125 V. D.C. A	B	ST.LTS. C	A. C. 60 CYCLE D	A. C. 25 CYCLE E	TOTAL F
41	Net Primary Generation				3487410		3487410
42	Primary Purchased				143000		143000
43	Net Primary Output				3930410		3930410
44	Input to Conversion				119920		119920
45	Output from Conversion	35600		72600			108200
46	Net Output	35600		72600	3812490		3918690
47	Used by Co. (Outside Power Sta.)	0			7627		7627
48	Electric Sales	26754		72600	3148829		3248183
49	Transmission & Distribution Loss	8846		0	654034		662880
50	Conversion Loss	11720		0	0		11720
51	Total Loss	20566		0	654034		674600
52	% Net Output	57.75		0	17.13		17.20

Balance sheet indispensable in studying system losses

DETAILED ANALYSIS OF LOSSES

		Plants A Main St.	A Hydro	B Power Co.	Substations C No. 1	D No. 2	E	F	G	Total X
53	NAME OR NUMBER									
54	Input to No. 1 Transformer Bank	2975000				*		*	*	*
55	Input to No. 2 Transformer Bank					*		*	*	*
56	Purchased H. T.			143000						
57	Total Input to Transmission	2975000		143000						3418000
58	Output to No. 1 Transformer Bank			20000	1478000	1487000				*
59	Output No. 2 Transformer Bank									*
60	Total Output from Transmission									
61	Input to P. F. Corrective Appar.									
62	Net Output from Transmission			20000	1478000	1487000				2985000
63	Transmission Loss	*	*	*	*	*		*	*	433000
64	Capacity No. 1 Transformer Bank	12000			6000	6000				*
65	Iron Loss K. W.	57.3			33	33				*
66	Hours in Service	786.5			744	744				*
67	Iron Loss K. W. H.	45051			24552	24552				*
68	Capacity No. 2 Transformer Bank									*
69	Iron Loss K. W.									*
70	Hours in Service									*
71	Iron Loss K. W. H.									*
72	Total H.T. Transformer Iron Loss	45051			24552	24552				90735
73	Transmission Copper Loss	*	*	*	*	*		*	*	342265
74	Net Output from Transmission			20000	1478000	1487000				2985000
75	Output from Other Sources	507660	4990							512650
76	Input to Dist. & Conversion	507660	4990	20000	1478000	1487000				3497650
77	Input to Arc Lamp Conv. Appar.	24300			48300					72600
78	Output Arc Lamp Conv. Appar.	24300			48300					72600
79	Loss	0			0					0
80	Input to Other Conv. Appar.	47320								47320
81	Output Other Conv. Appar.	35600								35600
82	Loss	11720								11720
83	Total Conversion Loss	11720								11720
84	Input to Distribution	500660		20000	1478000	1487000				3485660
85	Used by Co. (Outside Power Sta.)	4992			2735					7627
86	Electric Sales & Distribution Loss	495798		20000	1475265	1487000				3478063
87	Electric Sales	428943		20000	1298762	1487000				3248183
88	Distribution Loss	53357			176503					229860
89	Input to Distrib. Involving Loss	457590			853500					1311090
90	Recovery of Input to Dist.Inv.Loss	404233			676977					1081210
91	Distribution Trans. Capac.	2200			2700					4900
92	Distribution Trans. Iron Loss K.W.	17.20			21.125					
93	Dist. Trans. Iron Loss K. W. H.	12801			15717					28518
94	Meter Shunt Loss K. W.	5.02			7.28					
95	Meter Shunt Loss K. W. H.	3736			5420					9156
96	All Other Distribution Loss	36820			155386					192206
97	Efficiency of Distribution %	88.36			79.30					82.47

* Columns A and B, Combined

Form used for detailed analysis of losses

Conversion Loss—Next is determined the conversion loss and efficiency of conversion. This is usually a metered figure, and, in a general way, a legitimate loss. It is better, for analytical purposes, to neglect the loss on arc and street light conversion apparatus, such as tubs and rectifiers, and consider sales of this service equal to the input to such apparatus.

The only possible way the efficiency of the street-lighting system can be improved is by a change in the type of conversion apparatus or lamp, or in the size or length of the conductors. Therefore, an estimated figure for arc lamp conversion loss distorts the true conversion efficiency on other apparatus in the system with which it may be combined, and a condition that should be known would not be revealed.

Distribution Loss—Distribution loss is determined on each substation or section supplied, and a comparison of the efficiencies of distribution on these sections will tell where the recovery is the poorest. It is quite essential, therefore, that the efficiency of distribution be determined accurately. There is frequently some energy sold on the basis of the registration of a meter at a substation, such as arc circuits. It is evident that no part of the loss on that particular substation was incurred by the distribution of the energy so metered, and when determining the efficiency, such current should not be considered as put into that particular part of the distribution system. One can readily see that by so including this energy, the efficiency figures obtained would be improved, the amount of the improvement, of course, depending on the magnitude of such energy.

Distribution loss can further be divided into "distribution transformer iron loss," "meter shunt loss" and "all other distribution loss," the last being obtained by subtracting the sum of the two former from the total. This last embraces copper loss and all illegitimate losses occurring in the distribution system, such as stolen current, inaccurate metering, leaks, etc. The iron loss can be calculated with reasonable accuracy, knowing the number of transformers on the system, excluding those which have their losses metered, and the length of time such transformers were in service. The meter shunt loss is similarly calculated.

Finally, the classes of service sold may be analyzed, such as 125 volts or 250 volts, d.c., arc or street light circuits, 60 cycles and 25 cycles if such exist. This proves of particular value, because it is often found that

the losses on one class of service are entirely out of proportion to those on the other classes.

Reliability of figures in the analysis

Unless plant and substation meters are very accurate, true conditions will be greatly distorted. For example, a generator meter which read 1,980,000 kw.-hr. when it should have read 2,000,000 kw.-hr. would cause the total loss on the system to be 20,000 kw.-hr. lower than actual. This amount will ultimately appear either in the "transmission copper loss" or "all other distribution loss," and may be of sufficient magnitude to make either figure negative.

Inaccurate substation meters, since they are the dividing line between transmission loss and distribution loss, may seem to indicate that transmission loss is excessive, while in reality the reverse may be the case.

Calculated Losses—Inaccuracy of calculations of "distribution transformer iron loss" and "meter shunt loss" may cause a distortion in the analysis of distribution losses. Such items are usually determined on the basis of the number of transformers and meters in service at the end of the month and the total hours in the month, no attention being paid to those which were in use only fractional parts of the month. Such inaccuracies will affect the absolute value of "all other distribution loss," but the magnitude of the error is not great, provided fair average figures are used and no great changes have been made in the system during the month.

Meter shunt and transformer iron loss figures are quite constant from month to month, and even if the absolute value is not correct, the variation in "all other distribution loss" is still apparent and the reason for any sudden change can be investigated. High-tension transformer iron losses are calculated on the actual hours transformers were in use, and the core loss is obtained from the manufacturer's guarantee, which is probably reasonably accurate. If, because of voltage troubles, transformers in either the transmission system or the distribution system are operated on taps such that they are appreciably overexcited, the core losses may actually be very much higher than calculated. Under these circumstances excess core loss would naturally appear under "transmission copper loss" or "all other distribution loss."

Time of Reading Meters—One factor that largely enters into the inaccuracy of a monthly analysis is the time of reading large capacity meters. Large power customers may be billed on readings taken, say, the 20th of the month, and generation figured on readings taken the first of the month. During the short months, therefore, there is a larger sales period than generation period. It is advisable to read the meters of large customers as nearly as possible simultaneously with the generation and plant meters, but often this is not practical. However, frequently power meters may be read six or seven days from the end of each month, rather than on a specific date, and by so doing, the bulk of recovery will be over a period equal to that of the month in question. Any distortion in the results will then be due to the effect of a large number of small users and changes in operating conditions of the large users during the time of reading until the end of the month.

Other items that may affect the accuracy of an analysis are the overloading of instrument transformers and the use of fuses for meter potential transformers. Care should be exercised to see that current and potential transformers are not overloaded, otherwise the meter accuracy is greatly affected. This occurs most frequently in plant metering, and as the result is often reduced registration, losses may appear low. Use of fuses for potential transformers may cause a decided distortion, for often the failure of a fuse is not detected for some time. This is particularly true in the case of isolated substations which are visited infrequently.

Suggestion for avoiding losses

Every property should adopt a system of periodic inspection so that theft of current may be reduced to a minimum. Bookkeepers should be instructed and trained to watch for sudden changes in consumption and meter readers should watch closely for the presence of jumpers or suspicious signs about the meter. Such information should be forwarded to the proper department and the case should be investigated. Theft of current is at times difficult to detect, but evidence of guilt is usually sufficient reason for requiring the customer to install a protective device. Open wiring between the service outlet and the meter has been largely discontinued, and it hardly seems necessary to mention the undesirability of such practice at this time.

If the law relating to stolen current is sufficiently drastic, a conviction might be obtained, but in most states it is rather difficult to accomplish this, and undesirable from a public relations viewpoint. The law can be used as a threat to make the customer pay for the stolen energy and the installation of a protective device when the guilt of his theft is manifest.

Periodic Meter Tests—Since it is through meters that the greatest part of a utility's revenue is obtained, it becomes essential that regular and systematic steps be taken to maintain their accuracy. The frequency of such tests will depend largely upon the revenue derived from the particular meter. Direct-current meters usually require more frequent testing than alternating-current meters.

Premise Tests—The premise test is unquestionably the most effective means of maintaining accurate meters, for then local conditions, such as vibration and stray fields, are taken care of in the adjustment. With this practice, it also becomes unnecessary to remove and reset the meter, which entails additional expense.

Some sort of an installation test or inspection should be made on each large capacity meter within a short time, say one or two weeks after it is set. The degree of refinement to which this test is carried will depend largely on the way in which the meters are handled between the shop and the job and what experience has taught. Polyphase meters, particularly those employing instrument transformers, are frequently connected improperly, which often results in the loss of considerable revenue. An inspection of these by a competent man is advisable. When grounded secondary systems are adopted care must be exercised to see that the ungrounded side of the line is connected to the current coil of the meter. Errors that may occur in setting meters will then be corrected at the time of installation test or inspection.

Fusing Customers' Meters—There is possibility of considerable loss of revenue in the use of fuses for cus-

tomers' meter potential transformers. It is usually better to discontinue the fusing of such transformers, for the saving of a transformer will not compensate for the loss of revenue on a large meter due to the failure of a fuse. Frequent reading or checking of large customers' meters is essential to good operating practice, the frequency of checking, of course, depending on the revenue from the particular customer.

Care should also be exercised to prevent the overloading of instrument transformers on customers' meter installations. It is usually best practice to have a separate set of current and potential transformers for each meter installation of large size. Other instruments, such as relays, trip coils, ammeters, etc., should never be connected on a customer's watt-hour meter transformer.

Reduction of legitimate losses

As distribution systems grow and the load is increased, it frequently becomes necessary to operate transmission transformers on such tap connections as to provide satisfactory peak voltage. This results in overexcitation, particularly on off-peak periods, which causes a considerable increase in the iron losses in transformers; this may readily cause overheating, and might ultimately result in disaster.

In connection with a loss analysis, it is difficult to determine accurately what the excess iron losses are as a result of such overexcitation, with the result that the analysis would indicate an excessive copper loss, because the iron losses would necessarily be calculated on the manufacturer's guarantee.

On large systems it is current practice to purchase transformers with tap-changing equipment, so that taps can be changed without interruption to service, and, by virtue of this equipment, the magnetization losses can be kept close to those guaranteed by the manufacturer, since no overexcitation would result.

Power-factor Correction—It is at times thought desirable to operate synchronous condensers for power-factor correction on the transmission or distribution system. By comparing the results obtained by running the system for a time both with and without the use of this apparatus, it can be shown by analysis whether or not it is of advantage from a loss standpoint to operate in this way.

Change in Design of Distribution System—Having obtained reliable figures for losses, and being certain of reasonable accuracy of customers' meters, it is possible, by use of the analysis, to see what parts of the system are showing excessive losses and take steps to improve the physical condition. The use of an excessive number of transformers is apparent by comparing the relation of transformer loss to the energy supplied through such transformers. To check roughly an excess of transformers it is often customary to consider the ratio of total transformer capacity in a system to the total demand, but it must be borne in mind that in so doing there will be included a number of large transformers which are used on power service, and which should be considered independently of those on lighting service. Also a large part of the demand may be on installations metered at primary voltage, in which case such demand should not be considered in obtaining this ratio.

The analysis may also show that the high-tension transformer iron loss at a particular substation is far in excess of the energy sold at that substation, thereby indicating the advisability of making a change in the physical or operating conditions.

Voltage Regulation—Voltage regulation in general goes hand in hand with variation in losses, and it would be expected that a system having wide regulation would in general have a poorer recovery than one in which the regulation is good.

It would be well to point out that low voltage on incandescent lamps and most household appliances will cause a considerable reduction in revenue, to say nothing of the fact that by not maintaining proper voltage at the customers' premises service is much poorer. Overvoltage will cause burn-outs in lamps and appliances and furnish just reason for complaints, but by maintaining correct voltage, full revenue and good service will obtain.

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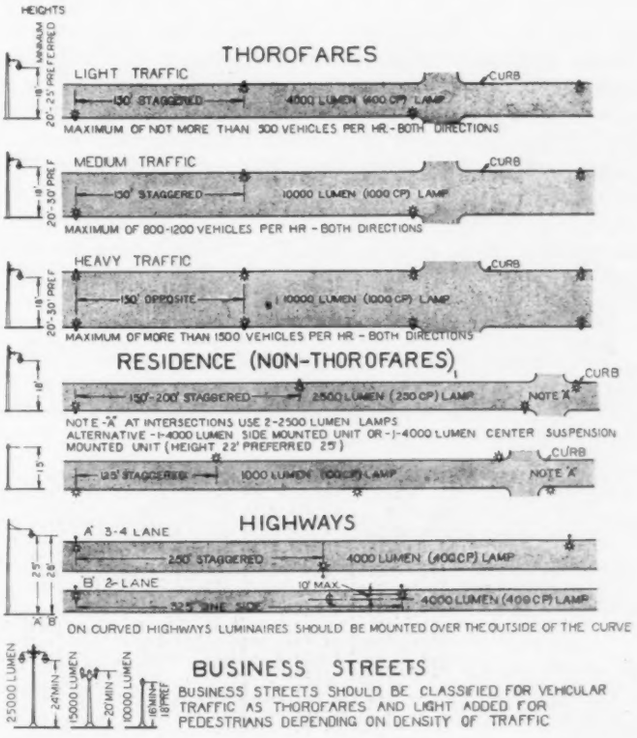
Street-Lighting Code at a Glance


HEIGHTS
THOROFARES
LIGHT TRAFFIC
CURB
130' STAGGERED
4000 LUMEN (400 CP) LAMP
MAXIMUM OF NOT MORE THAN 300 VEHICLES PER HR.-BOTH DIRECTIONS
MEDIUM TRAFFIC
CURB
130' STAGGERED
10000 LUMEN (1000 CP) LAMP
MAXIMUM OF 800-1200 VEHICLES PER HR - BOTH DIRECTIONS
HEAVY TRAFFIC
CURB
150' OPPOSITE
10000 LUMEN (1000 CP) LAMP
MAXIMUM OF MORE THAN 1500 VEHICLES PER HR. - BOTH DIRECTIONS
RESIDENCE (NON-THOROFARES)
CURB
150'-200' STAGGERED
2500 LUMEN (250 CP) LAMP
NOTE 'A'
NOTE 'A' AT INTERSECTIONS USE 2-2500 LUMEN LAMPS
ALTERNATIVE - 4000 LUMEN SIDE MOUNTED UNIT OR + 4000 LUMEN CENTER SUSPENSION MOUNTED UNIT (HEIGHT 22' PREFERRED 25')
CURB
125' STAGGERED
1000 LUMEN (100 CP) LAMP
NOTE 'A'
HIGHWAYS
A 3-4 LANE
250' STAGGERED
4000 LUMEN (400 CP) LAMP
B 2-LANE
10' MAX.
325' ONE SIDE
4000 LUMEN (400 CP) LAMP
ON CURVED HIGHWAYS LUMINAIRES SHOULD BE MOUNTED OVER THE OUTSIDE OF THE CURVE
25000 LUMEN
15000 LUMEN
10000 LUMEN
BUSINESS STREETS
BUSINESS STREETS SHOULD BE CLASSIFIED FOR VEHICULAR TRAFFIC AS THOROFARES AND LIGHT ADDED FOR PEDESTRIANS DEPENDING ON DENSITY OF TRAFFIC

To simplify grasping the features of the I.E.S. Street-Lighting Code, presented last year, the major requirements have been worked into the accompanying graph by A. F. Dickerson, chief engineer, illuminating engineering laboratory, General Electric Company, who says that it meets with the street-lighting committee's approval. Spacings shown represent the maximum recommended with the mounting height illustrated and the lamp sizes are the minimum for spacings and mountings shown. The recommendations are based on the most effective equipment used in the most effective manner.

Declares Rural Lines Cost Too Much

Commission engineer finds neither rhyme nor reason in farm line building practices as regards costs or quality. Contends adequate low-cost construction should be standardized.

DURING the very early period of interest in the extension of electric service to farm customers the power companies had aristocratic ideas of how rural lines should be built. And some of them still have such ideas. So asserted J. Howard Matthews, chief engineer Illinois Commerce Commission, at the recent convention of the Great Lakes Division, N.E.L.A., in his talk on "Some Rural Electrification Problems from a Regulatory Viewpoint." Mr. Matthews instanced costs at the start of rural service interest of from $1,500 to $2,000 per mile of line. When these costs did not decline so rapidly nor so consistently as they should the Illinois commission began to study the matter. But let Mr. Matthews tell his own story:

"The commission's engineers started to do some work on construction standards. Utilities were skeptical and suspicious. When a commission engineer gets a notion of some kind he gets plenty of watching from every direction. But the engineers persisted and ambitiously promulgated some tentative standards for construction. These proposed rules set up a standard which it was thought would insure safe and serviceable lines for rural service and at the same time would prevent unnecessarily high investments and consequent undue burden on subscribers to rural service. We rather expected the utilities to object on the grounds that these standards for farm service were too low. Instead of that, to our amazement, they arose *en masse* and said our strength requirements were unreasonably high and that such excessively high standards would discourage rural business by making construction too expensive.

"What happened during the next year or two is history in Illinois, and real live history to most of our utilities, but it is even more interesting history that since the establishment of those standards our problem has been to get the utilities to build *down* to our standards rather than *up* to them. Construction engineers of the better utilities could not persuade themselves that anything short of a class B pole, or one with a 7 or 8-in. top, could support a couple of wires without buckling from dead weight, or that poles set farther apart than 130 ft. could prevent a line turning over even in a light summer wind. It is probably sufficient to say that the utilities which were spending $1,500 to $2,000 a mile for construction were gradually educated to build rural lines for approximately $900 a mile or less and with factors of safety still running from 2 to 5. In fact, our studies have indicated, and actual practice has proved, that rural lines adequate in every respect to handle rural service can be built for figures as low as $600 per mile, exclusive of transformers, and still offer a factor of safety well beyond reasonable minimum requirements for this class of construction.

Rural Line Costs from Six Illinois Utilities

	Material Costs‡	Labor Costs	General Office Expense	Miscellaneous Costs¶	Total Cost per Miie	Man-Hours of Labor	Factor of Safety
Co. A							
Line No. 1	$674	$139	$204	$97	$1,114	227	2.95
Line No. 2...	844	358	249	106	1,557	455	3.13
Line No. 3..	1,018	446	225	204	1,893	687	3.96
Co. B							
Line No. 1....	1,004	229	140	23	1,396	424	2.20
Line No. 2....	641	262	101	8	1,012	484	1.88
Co. C							
Line No. 1....	865	312	160	35	1,372	625	3.75
Line No. 2....	880	327	123	27	1,357	793	6.38
*Co. D							
All lines.....	440	205	73	83	801	264	2.90
†Co. E							
Line No. 1....	364	106	23	63	556	174	4.10
Co. F							
Line No. 1....	674	153	Included in labor costs	Included in material costs	827	381	3.20

*All total figures except in the case of Company D include the cost of transformers installed.

†Further break-down for Company E: poles, $162; wire, $117; other material, $68; stores expense, $17; total material, $364; labor, $106; general office expense, $23; miscellaneous expense, $63; final total, $556. Since these $556 lines were built there have been reductions in the prices of both poles and wire.

‡Include freight and stores costs.

¶Include insurance, interest, transportation truck, board of men and other miscellaneous expense.

Variables are indeed variable

"There is still room for considerable research into the economics of rural line construction. We have analyzed some of these costs and from a study of the figures it is apparent why there is still such a wide variation in rural line costs.

"Material costs alone vary from $365 to $1,000—$400, $500, $600, $800 or $1,000. Anything you like, apparently, without any particular reason; a variation within the same company of $300 to $400.

"Labor costs range from $100 to $450, again with no apparent reason. Some companies add $25 and some add ten times that much for general office expense. Miscellaneous costs, including insurance, interest during construction, transportation expense, are almost anything up to $200. The final total cost per mile ranges from $500 to $2,000. Nor are these differences accounted for by variations in labor rates. To find out about this we have analyzed the man-hours of labor shown by the different companies. One of the smaller utilities which has made a strenuous effort, and quite obviously an effective one, to reduce labor costs is building such lines with 175 man-hours per mile. We find that a few of the large companies, by careful study, are reducing their time to somewhere around 200 man-hours, but the others are still using 300, 400, 500 man-hours, and even as high as 800, and in a formal proceeding recently before our commission, two of our larger utilities concurred in an exhibit which set up labor costs for single-phase rural lines at $800 per mile. This means that it would take some 1,300 man-hours (one solid month) for a five-man gang to build one mile of rural line, or from three to seven times

as much labor as the utilities which are watching and studying this problem are generally finding necessary.

"Neither are the wide differences accounted for by construction difficulties or factors of safety. The lowest cost line has a factor of safety of more than four, against two for the company showing the highest costs. These values are interesting, too, in the light of our rather notorious controversy of a few years ago relative to strengths of lines. Several of the companies which were particularly disturbed at that time, when the commission's engineers suggested the "unreasonably high" factor of safety of 1½, are still insisting (just as they were doing then, by the way) on constructing lines with a factor of safety ranging from three to six.

Topheavy overhead

"In the case of one company, the cost of general office supervision is $204, which is $65 more than the total labor costs, and there is an additional miscellaneous expense of $97, making a total of more than $300 of overheads and "extras" in a line where the total labor cost is less than half that ($139).

"The final costs, where low, seem to be explained, not by any one cause, but by an accumulation of them—good judgment in the selection of material, low overheads and very efficient use of labor.

"It goes without saying that construction costs should be kept as low as consistently possible because these costs have such an important bearing on rates, and, as I believe is readily apparent from the above discussion, considerable thought could well be given by a number of utilities to the most suitable mechanical design of line."

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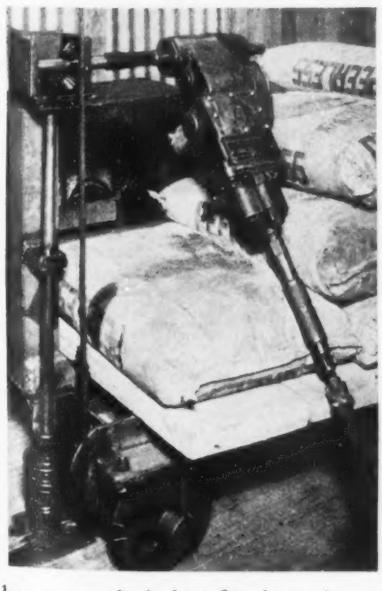
Scaffold Hoists Operated by Compressed Air



Scaffold hoists, by means of which masons and others wind themselves and their impedimenta up the sides of buildings, are often tiresomely reminiscent of the old grindstone out in the barn. Such painful memories do not visit the masons on the Detroit Edison Company construction jobs for they enjoy the scaffold winder pictured here. It is just like any other except that it has a high gear ratio and has a mandrel that fits into the socket of a compressed air drill.

Electric Arc Welding in Mines

By CARL LEE
Electrical Engineer Peabody Coal Company, Chicago, Ill.

Around coal mines a very substantial saving can be made in salvaging worn or broken parts of machinery by means of electric arc welding. This is now being done at the majority of operating mines.

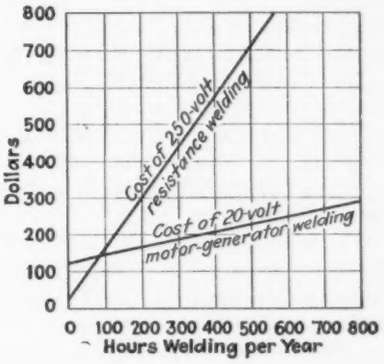
The various types of equipment such as tipple machinery, cages, loading machines, mining machines and locomotives usually consist of a large number of operating parts which are subject both to wear and breakage. As a rule the complicated shape of special machine parts makes them very expensive in first cost. If such parts can be salvaged by welding and machining, and such repaired parts are essentially as good as new, then it is a question of what the repair cost amounts to in comparison with new cost, whether or not the process is economical. Electric arc welding is very well suited to a good portion of such work. On the simplest work and on small jobs the resistor welder operating on the 250-volt mine circuit can be used economically. However, when the volume of work and complexity of the work increases, then it is desirable and economical to install a motor-generator, constant-energy type of arc welder. Then better work can be performed and a material saving in power cost realized.

Resistance welding vs. motor-generator set

For more than 85 hours of welding time per year it is cheaper to use a motor-generator set on the following bases:

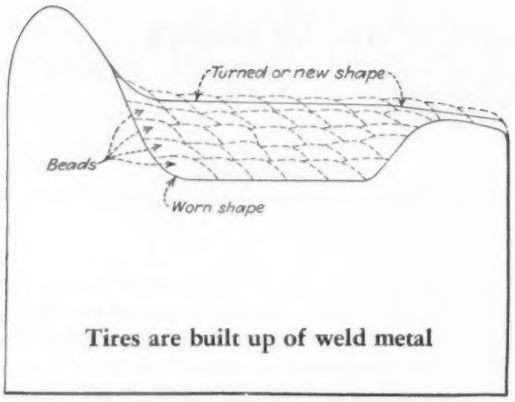
Assume arc current, 150 amp.; arc voltage, 20; motor-generator welder voltage, 20; mine voltage, 250; mine motor-generator set efficiency, 70 per cent; welding set efficiency, 50 per cent; power cost a.c., 2½ cents per kilowatt-hour; cost of welding motor-generator set, $750; cost of resistor welder, $150; interest and depreciation, 16 per cent per annum; interest and depreciation, $120 per annum on motor-generator welder; interest and depreciation, $24 per annum on resistor welder.

The operating cost with resistor welder is $1.35 per hour. The cost with motor-generator set welder, constant energy at 20 volts = $0.21 per hour plus interest charge.



In building up axles and other cylindrical work by hand the bead is usually run longitudinally with the axles. This is open to the objection of leaving the axle or shaft bent or warped. To overcome this the work may be placed in a rotating device and the weld made in a spiral. This, then, becomes a good application for an automatic welding head.

Recently several mines have installed full automatic General Electric welding equipment for filling in or building up worm treads and flanges of locomotive tires and wheels. Such an installation is in operation at the



Tires are built up of weld metal

A typical shape of tire contour when received out of mine service is shown by the full solid line in the sketch. The beads are laid on as shown by the lighter lines and the tire after being filled and turned is in the shape of the outside smooth line, approximately the same as a new tire.

Peabody Coal Company mine No. 9, near Taylorville, Ill., and consists of a lathe with special back gearing to run it at a very slow speed so as to give 7 to 9 in. travel per minute on the circumference to be welded. By means of the regular back gearing, the double cone pulleys and armature rheostatic control this speed is obtainable for all diameters from 2 in. to 40 in.

Two General Electric automatic welding heads with 300-amp. motor-generator sets are used. One is driven by a d.c. motor and is portable, so that it may be taken into the mine for emergency work. The two welding heads with control panel and auxiliary motor-generator set are permanently installed near the lathe. All control buttons for heads and lathe are mounted near the lathe.

The truck or other shafting is supported and revolved in the lathe and the two automatic welding heads are supported by a special adjustable frame carried on the usual tool carriage of the lathe. The bed feed moves both heads along to give about $\frac{3}{16}$ in. travel per revolution, so that a spiral-bed $\frac{3}{16}$-in. pitch is laid on the work. This outfit has been used principally on filling steel tires. Since December 17, 1930, through June 30, 1931, there have been 201 tires filled and 50 axles built up to standard. The tires average about 50 lb. of electrode used, which is laid on at about 4 lb. per hour. The capacity for two heads at this rate is $1\frac{1}{2}$ tires per eight-hour day, or for 250 days equals 375 wheels per year.

Some breakage has been experienced, but it is thought that this may be partly attributable to the tires having been shrunk on the centers too tightly in the first place. Considerable experimenting was done at first to determine the proper procedure to minimize this trouble. It was decided to preheat the tires with a kerosene torch to 200 deg. F. or more before starting the welding, so that the strains set up in the tire by the weld metal would be minimized. An actual measurement of one tire welded on a mandrel indicated only 0.0046 shrinkage during welding and this amount is only about $\frac{1}{10}$ that allowed for original shrinkage on the centers. The original shrinkage should not be excessive; about 1 mil shrinkage per inch of diameter should be sufficient.

A flux-coated electrode of about 0.15 carbon appears to give satisfactory results in so far as the wearing of the tire is concerned. The flux coating permits a current of 200 to 250 amp. to be used with fair results. Low carbon steel results in better traction on the rails than if high carbon hard steel were used. While tires have been the principal work on this installation, axles and other special jobs have been conveniently handled, and there are many applications of hand welding that have been made during intervals between tire filling. It is apparent that this installation will save considerable money on maintenance of mechanical parts at this mine and others of the same group.

Cost per Wheel

Electrode, 50 lb. at 8 cents	$4.00	Average cost new tire	$25.00
Per 100 kw.-hr. at 0.025	2.50	Saving per wheel	10.00
Labor, say eight hours	7.50	Saving per year 375 x $10.80	4,050.00
Total	$14.00		

This would be about 100 per cent on initial outlay

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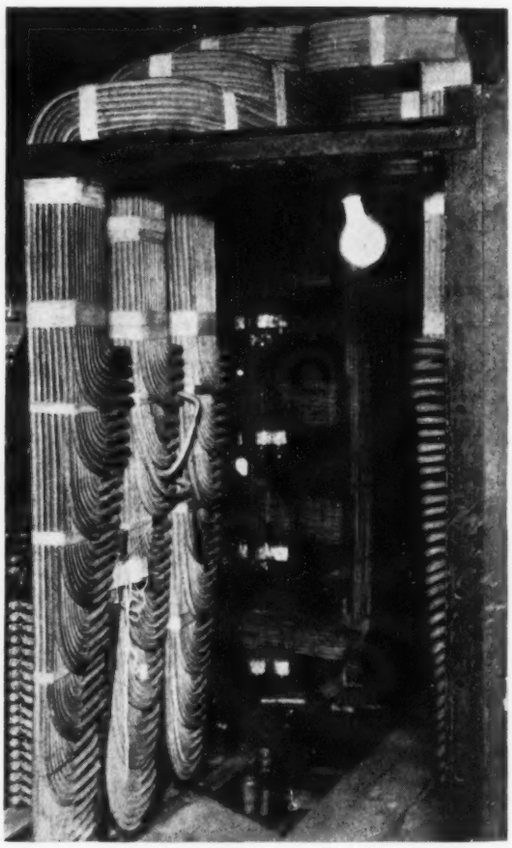
Telephone-Type Wiring Saves Space



Both improved appearance and reduced space requirements resulted from the adoption of telephone-type wiring for booster-pump rheostats at the South Amboy station of the Jersey Central Power & Light Company. Similar wiring arrangements were followed wherever feasible at this plant and are standard practice with the Electric Management & Engineering Corporation, designer and constructor of this station.

Modernizing a Chemical Plant's Electrical Energy Supply

By W. S. JOHNSTON
Boston, Mass.

SAVINGS in insurance premiums went far toward paying the fixed charges on a modernized electrical supply layout for a growing chemical plant which purchases energy from a local utility system. The industrial company began operations about ten years ago in a small way, buying power from the start for the manufacture of intermediate pharmaceuticals and dyestuffs. The growth of the business necessitated improvements in the distribution system in accord with more symmetrical development and better co-ordination of plant feeder layouts to meet changing load conditions.

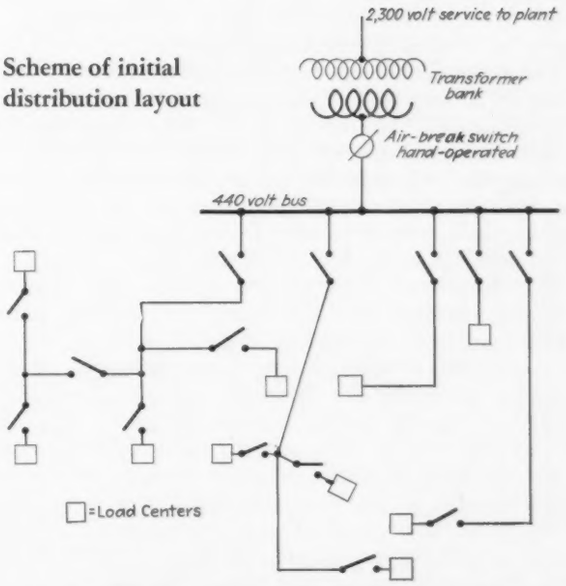
When the plant began business energy was received at 2,300 volts and stepped down at an 800-kva. transformer bank connected to a bus behind the switchboard. The feeders were run from a distribution bus, also located behind the board, to the various units of the plant. As the demand for the company's products increased the process facilities were extended from time to time until the entire capacity of the step-down substation had been allocated to the different departments. Power was furnished the new building additions by extending feeders and adding new feeder sections to the existing switchboard. These extensions and feeders were not always as well arranged as with new construction, the layout being uneven and unbalanced.

In some cases triple-braided weatherproof conductor had been run more or less promiscuously through the buildings, where it was entirely exposed to and very often attacked by chemical fumes. The condition of the insulation became worse with time. Chemical reaction also set in on the exposed parts of switches in different departments.

About two years ago the situation required immediate action. The step-down station was inadequate in capacity, the switchboard could not be extended in the limited space available, switches were becoming inoperative due to blade corrosion, insulation on exposed wiring became poor, insurance rates were increased due to the extra hazard arising from the condition of the wiring and several small fires had occurred which were attributed to the electrical system.

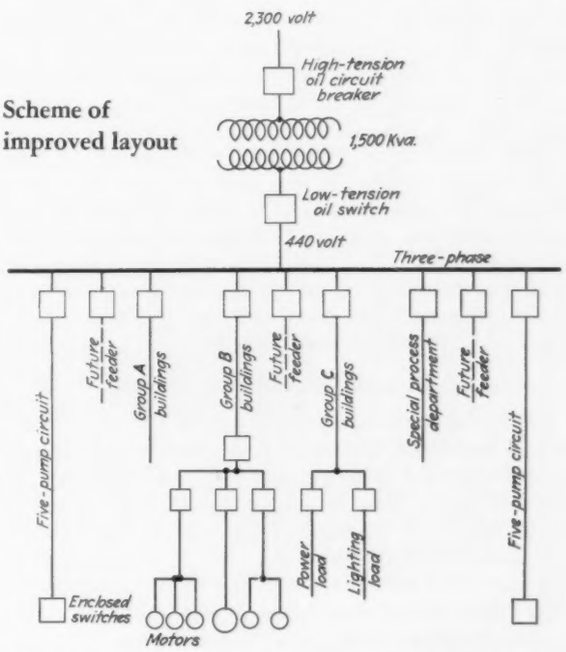
The management desired to modernize entirely the electrical layout for not only the present power requirements but to incorporate some margin over present needs in the capacity of the substation, switchboard and feeders for future growth, to decrease the insurance premium, minimize the possibility of more fires and, in general, make the system safe for the operators. Engineers were therefore retained to lay out a new system.

Scheme of initial distribution layout



Feeders became crowded upon a switchboard bus less than 20 ft. long, with control by hand-operated knife switches, no cell isolation and hit-or-miss runs to departments.

Scheme of improved layout



1,200 hp. in 40 motors served from a 35-ft. bus, with oil switches on individual feeders, steel cell construction for fire protection, and symmetrical feeder service throughout plant.

In discussing the voltage at which electrical energy would be purchased, the management had in mind specifying 2,300 volts and using some of the energy at this potential for driving certain 50- and 75-hp. motors throughout the plant. The existing 440-volt motors had given a good many years of satisfactory service, but the management was willing to dispose of them and purchase 2,300-volt motors. However, in discussing the subject with the public utility's engineers, it developed that the 2,300-volt equipment would be more costly throughout than the corresponding 440-volt equipment, the operating and protective devices would be considerably more expensive and it might be safer to avoid the use of the higher voltage in the process buildings.

The power engineers retained further pointed out that it would be necessary to take a tap off the public utility company's 2,300-volt line ahead of the transformers and install additional oil switches which would entail further expense. It was finally concluded that the 440-volt motors then in operation could be reconditioned at small expense and, over a period of years, would probably be as economical as the higher voltage motors.

The improved arrangement brings the 2,300-volt incoming feeder into the plant through an outdoor remote-operated oil circuit breaker with a solenoid, direct-current, mechanical trip-free mechanism operated from the incoming line through a suitable power transformer supplying a copper oxide rectifier. This combination eliminated the use of an alternating-current motor mechanism which in itself is inherently complicated because of its many moving parts. It has the added advantage that the simpler direct-current solenoid incurs practically no maintenance expense in comparison with the alternating-current motor mechanism.

The public utility line, after going through the high-tension breaker, supplies the outdoor transformer bank. The transformers are three single-phase units, connected delta-delta, of 1,500 kva. total capacity. The connection is made delta delta to permit open delta operation in case of trouble with one unit, permitting continued operation of the more important processes.

On the low-tension side of the transformer bank is another oil switch mounted in a completely inclosed, outdoor switch house. The switch house is equipped with a control and relay panel and the breaker is operated in a manner similar to the high-tension breaker. The tripping of both breakers is accomplished by use of transformer trip coils with direct trip attachments and overload relays. A 125-volt battery for tripping all the breakers, including those on the feeders, was installed in a well-ventilated room in the adjoining building, where also the switchboard was located.

One low-tension bus sufficient

While the high-tension line coming into the plant was carried overhead, the leads from the low-tension breakers were carried underground and fastened solidly to the 440-volt bus. This bus at present has one source of supply only, but, because of the rugged equipment used, it is anticipated that outages due to the failure of the equipment are minimized and the manufacturing plant is more likely to be shut down from line trouble external to the substation than from failure within.

Each feeder is equipped with a carbon breaker mounted in an inclosed steel cubicle. The bus and all connections to the breakers are similarly inclosed and dead-front panels are used. Indicating meters are mounted on the fronts and are fitted with special air-tight cases to keep out acid and other chemical fumes. All of the switchboard wiring between the meters is impregnated to withstand corrosive fumes.

The feeders pass from the main switchboard to the various manufacturing buildings on overhead structures. The first structure immediately outside of the switch room is a steel tower designed to take the strain due to the load of all the feeders and thus dead-ends the system and relieves any strain passing through to the switching structure. The short runs between the switch room and the steel tower are anchored by guys to the building wall. All other line structures are wood poles set single or in H formation. The overhead outside conductor has triple-braid, weatherproof insulation carried on regulation insulators.

Glazed conduit installed in acid departments

Through a majority of the plant buildings the engineers used flameproof braid, rubber-insulated cable, carried on insulated racks to minimize fire hazard. However, in the acid departments they used rubber-insulated conductor carried in corrosion-resistant, glazed-metal conduit, further protected from the corrosive fumes by being painted with a non-metallic neutral pigment.

Due to the necessity of continually supplying the plant with energy and in view of the major nature of the changes necessary, advantage was taken of the annual two weeks' vacation period, during which time the entire plant was shut down to revamp the electrical layout. The equipment and all necessary material were assembled for quick erection. No better location for the substation could be found than that occupied by the old one. The old foundations could be used and the mat was extended for the new transformers while the old substation was yet in service. It was felt desirable to install the new main low-tension switch structure in the same location occupied by the then present board. This required dismantling the old board and erecting the new one complete within the fortnight.

To safeguard the fire pump service at the river front duplicate underground lines were provided independently of each other from the switchboard to the pumps by different routes, with manholes protected against flood stages exceeding the highest on record.

With the above improvements the plant now possesses a modernized supply system simple in scheme but adapted to future expansion.

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Water-Power-Site Survey by U. S. Forest Service

Long-time planning for the development of the water-power resources within the national forests, which are estimated to embrace 25 per cent of the nation's water-power wealth, is the aim of a survey to be undertaken soon, the United States Department of Agriculture announced recently. Lands within the forests having water-power potentialities will be classified, and especially careful study will be given to those regions in which power development might interefere with logging, recreation or other forest uses. The work will be done by federal officers in connection with other field activities.

Standard Telephone Cable Has Solid Pulp Insulation*

By H. G. WALKER
Development Engineer in Charge of Pulp Insulation
Western Electric Company

Pulp insulation of wire conductors in telephone cables, to replace the familiar ribbon paper method that has been standard for 40 years, is one of the important recent accomplishments in the improvement of telephone apparatus and equipment. Essentially, this development has brought the paper mill into the cable plant and combined it with the insulating process so as to eliminate some costly intermediate steps.

The pulp-insulating machines are of a new type developed for the express purpose of applying pulp to wire and are something of a cross between wire-handling and paper-making equipment with numerous mechanisms especially designed for the job in question. Four of these machines are now in operation, two at the Hawthorne plant of the Western Electric Company and a like number at the Kearny plant, with an output of approximately two hundred million conductor feet per week. The insulation itself consists of a continuous uniform sleeve of porous paper surrounding the wire but not adhering too tightly to it. The cables made from this material are of the new multiple-unit type construction, the development of which came from the laboratories at an opportune time to fit in with the pulp program and make its success more certain. They are of the same size as the older ribbon cables and possess similar though not identical physical and electrical characteristics. The operating characteristics of the pulp wire cables, once they are in service, are for all practical purposes identical with those of the older type. At one stroke methods, products and raw materials have been cut loose from all previous experience and the task of working out a complete, new and revolutionary process has been taken up in earnest.

While the fundamentals of the process were apparent, the combining of them into a single production unit of commercial size, capable of making a product with the required characteristics, offered difficulties that required time, money and the combined talent of all the cable groups in the Bell System for their solution. The outstanding developments which made production possible were the electrolytic removal of residual drawing compound from the bare wire before it reached the pulp-depositing mechanism, so as to give a clean surface for contact with the pulp; the modification of the properties of the suspension of pulp in water by the addition of a small amount of soap to give a uniform sheet on the conductor; the ingenious mechanism for forming the sheet into a continuous, somewhat loose, sleeve around the conductor, which practically eliminated insulation breaks under normal conditions, and the drying of the insulation in a red hot furnace so rapidly as to minimize shrinkage and leave the insulation in a porous and concentric state as required for the best results in cables. The extension program has been carried out as it was planned, and early this year the standardization of all 24- and 26-gage cables for manufacture from pulp wire was completed. This new type cable is being regularly supplied to the operating companies in large quantities and it compares favorably in all respects with the older ribbon type. It is a new product, but it is behaving very satisfactorily, and it can be confidently predicted that, as a background of experience is built up, further improvement in quality will be reflected in its performance.

The making of pulp insulation is a new art and a valuable one. It is not a finished art and it is still too young for all of its possibilities to be appreciated, but it is now established as a definite part of telephone cable manufacture, fully paying its own way and holding out the promise of substantial economies. It is gradually supplanting the ribbon-insulating process for fine wire cables and, as soon as practicable, its possibilities as to coarser wire cables will be investigated.

From "An Important New Insulating Process for Cable Conductors," an exposition by H. G. Walker in the Bell Telephone Quarterly for October, 1931.

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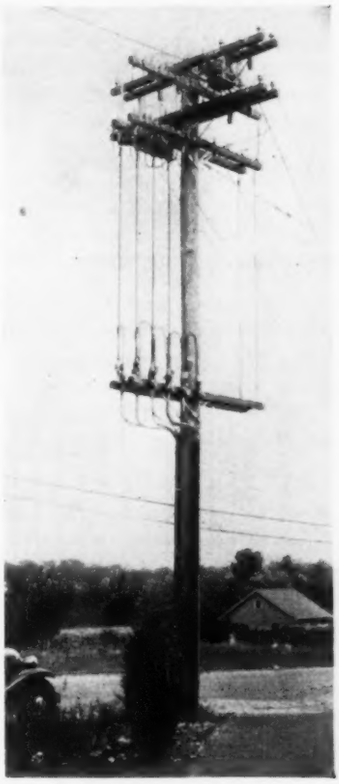
Economical Take-off Construction



Take-off pole at West Concord substation

Connections between the underground and overhead feeders from the Boston Edison company's West Concord substation to the town's distribution center are made at poles on the premises by the construction illustrated, with a minimum use of material and on lines convenient for the underground crews' work. The underground 4-kv. feeders leaving the station terminate in potheads at the lower cross-arm level. The outgoing overhead lines are dead-ended at these arms, short taps being provided for the pothead connections. Plug fuses, lightning arresters and hand-operated feeder disconnecting switches are mounted on the upper arms, and the outer ends of the unused cross-arms are tier together by wire to provide rigidity. The construction makes it unnecessary for underground men to do any pole climbing, and the use of open wire between the upper and lower arms was cheaper than cabling.

Advantages of Slag-Tap Furnaces

By E. G. BAILEY and R. M. HARDGROVE *
President and Research Engineer, Respectively, Fuller Lehigh Company

THE coal-burning equipment installed in a plant often controls the kind of coal that must be burned to obtain the required capacity; otherwise, capacity and perhaps efficiency of a given equipment are limited by the amount of ash and the nature of ash in the coal. With a view to removing as many of these limitations as possible, many improvements have been made in furnace construction and ash-removal methods during the past ten years.

When the fusing temperature of ash in the coal is higher than the furnace temperature the ash remains as dust. Some of it accumulates on the furnace bottom as well as on the walls and heating surface, the amount so deposited depending upon the size of the dust particles and the velocity obtaining through the furnace and gas passages.

Where the fusing temperature of the ash is appreciably below the furnace temperature the particles of ash become molten globules, which adhere tenaciously to almost any part of the furnace or heating surface with which they come in contact. That which accumulates on furnace walls melts and flows downward, fluxing and eroding any hot brickwork or refractory material that may be present. The accumulation of this ash on the furnace bottom is likely to become congealed and build up into a solidified mass that is difficult to remove. These molten particles also adhere to the boiler heating surface, building up slag or accumulating in forms varying from that which will drip from the tubes to a spongy mass which chokes the gas passages and requires hand lancing in addition to the regular soot-blowing operation.

Where the fusing temperature of the ash is approximately equal to the temperature of the furnace a combination of these two previously described conditions exists. The ash may flux and erode the walls at times of high rating and build up into undesirable slabs of vitrified slag at times of medium or lower rating. The ash accumulating in the furnace may not entirely vitrify, but it becomes congealed sufficiently to make the removal difficult.

As the tendency today is for higher capacities and better efficiencies, which call for relatively low excess air and high furnace temperatures, the problem of handling the ash in the furnace and removing it, as well as preventing its detrimental accumulation on the boiler tubes, has received much attention. The boiler tubes immediately above the furnace have been spaced wider apart, with a special arrangement known as a slag screen, whereby the choking up of the gas passages has been minimized, even when high ratings are produced with coal having a low-fusing-temperature ash. Water walls have become almost universally accepted as the answer to the problem of carrying high furnace temperatures with low-fusion ash and, at the same time, relatively low maintenance cost of walls and arches.

The removal of ash from the furnace is accomplished in four ways.

1. The admission of cooling air near the bottom of the furnace, so that the ash falling into this zone is chilled before conglomerating into a mass on the floor proper. Such floors may consist of flat refractory bottoms from which the ash is hoed or sluiced out with little difficulty or labor and low maintenance cost. This method, however, has its limitations as to the furnace temperature and ash fusion.

2. A similar furnace bottom, either flat or hopper, with water-cooling tubes spaced across the furnace a short distance above the floor, so as to add to the cooling of the ash as it accumulates on the floor. This water-cooling tube construction may be used to supplement the air cool-

Excerpts from address presented before third International Conference on Bituminous Coal, Carnegie Institute of Technology.

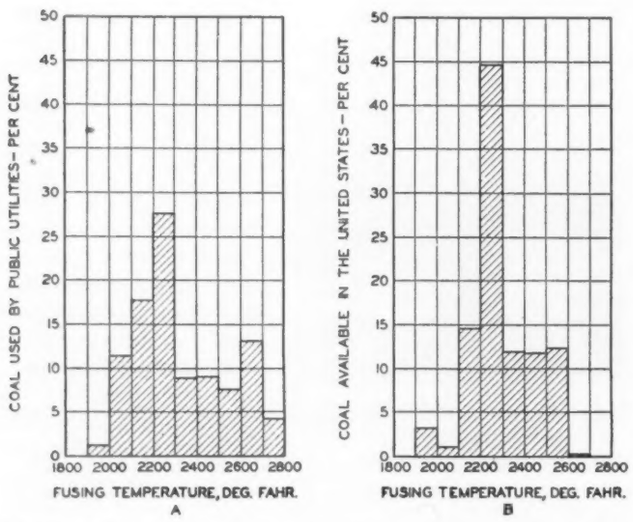


Fig. 1a and b—Most steam coals available and used have ash-fusing temperature below 2,500 deg. F.

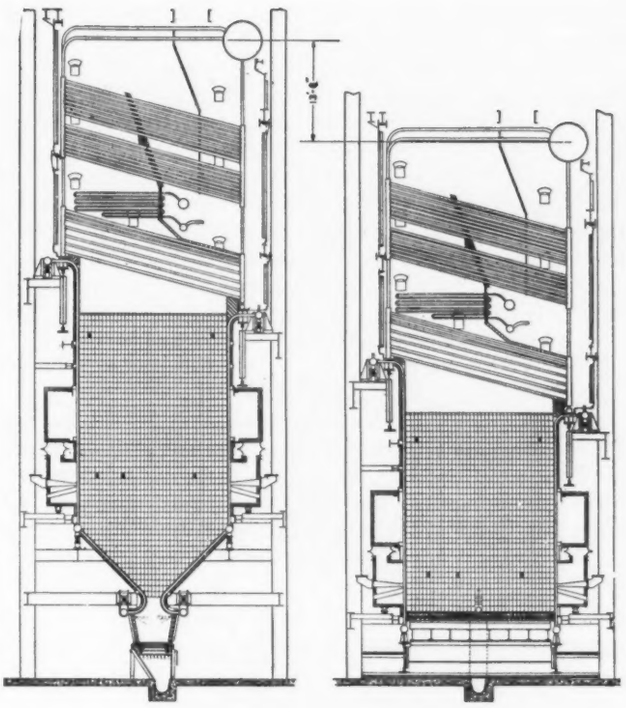


Fig. 2a and b—Slag-tap furnace is 13½ ft. lower than corresponding hopper-bottom furnace

The molten slag flows down over the hopper of furnace (a) and drips into the ashpit, where it is chilled with water sprays.

ing, or replace it. There is a certain amount of air cooling always present.

3. A water-cooled hopper-bottom furnace, where the ash is chilled as it accumulates and where the floor is composed of relatively smooth cast-iron blocks or tubes, so that the ash falls or rolls by gravity into the pit, without adhering to or accumulating into objectionable masses on the floor of the hopper. When low-fusion-ash coal is burned at high rates of liberation and high furnace temperatures the ash usually flows down such a hopper bottom in molten or semi-plastic condition and drips into the ash-pit. This type of furnace bottom is more nearly universally applicable to the burning of both high- and low-fusing-ash coal at high and low ratings than any other furnace bottom so far developed.

4. A slag-tap furnace wherein the ash which accumulates on the bottom can be retained in molten condition until periodically tapped out in liquid form. Such a furnace bottom naturally has no cooling by air or water tubes above the zone where the ash accumulates. On the contrary, the flame from the burners can be directed immediately above the floor or be caused to impinge against the slag accumulating in this zone to keep the ash in a molten condition. Several furnaces involving this construction have been installed during the last five years. Since 87.5 per cent of all coal available in the United States and 75 per cent of all coal used by utilities has an ash-fusing temperature below 2,500 deg. F. it falls within a range calling for water-cooled walls and special consideration for ash removal. The slag-tap furnace is particularly adapted to such coal. By its use premiums paid for coals having a high fusing temperature can be avoided.

One of the principal advantages of the slag-tap type of construction is the reduction in the height of the furnace and the corresponding saving in building cost. Fig. 2 shows two boilers of identical construction, with furnaces of the same width, depth and method of firing, (a) a hopper or continuous type of ash removal and (b) having an intermittent or slag-tap method of ash removal. In this comparison it is noted that there is an actual saving of 13½ ft. in building height. The rates of heat liberation in the slag-tap furnaces are in general much higher than can be used with water-cooled furnaces designed for dry ash removal.

With furnaces designed for dry ash removal the ash usually sinters more or less, and extensive poking and barring are required to get it worked into the sluice or ash cars and the basement is either very dusty or sloppy, or both. Compared to this operation, removal of ash from a slag-tap furnace consists simply of starting the flow and letting it run into the sluice. From there it is piped to the place of its disposal either for filling or removal from the dump to cars. The time used in tapping varies from one hour to 1¼ hours per day, and the same operator often has several furnaces tapping at once. The basements are clean and dry.

In furnaces designed for dry ash removal, where the ash has a high fusing temperature and the cooling is sufficient to allow the ash to be removed dry, the ash recovered in the furnace is usually only 10 to 15 per cent of the total ash. Of the remaining 85 to 90 per cent, a small part is collected in the settings and the remainder emitted from the stack. Water-cooled-furnace walls with rough or refractory-faced blocks over the tubes are hot enough on the furnace side to be completely wetted by the continuous flow of molten slag over the surface, with the result that a much larger percentage of the ash is caught on these walls. Even with a hopper-type furnace bottom as illustrated in Fig. 2a recoveries as high as 30 per cent have been obtained with low-fusing-temperature coal.

With the slag-tap furnace even more ash is retained in the furnace. Typical recovery figures vary from 30 to 43 per cent of the ash in the coal. The recovery varies some with rating as shown by Fig. 3. The importance of being able to collect in the furnace 40 or 50 per cent of the ash, instead of 10 to 15 per cent, cannot be overestimated, as it means a greatly reduced nuisance

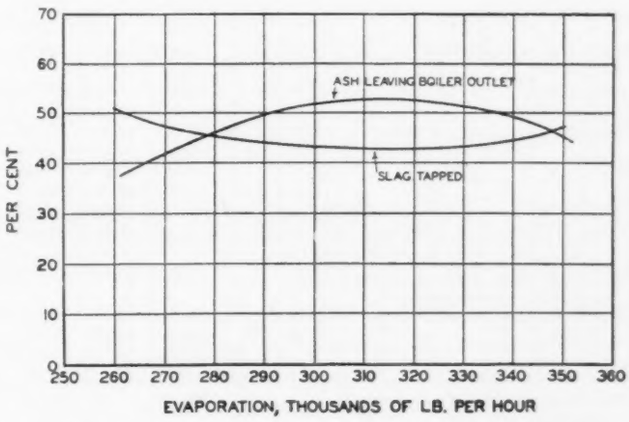


Fig. 3—Ash recovery at different boiler ratings with slag-tap furnace in Fig. 4

from dust emitted by the stack or less expensive equipment for the removal of dust from the flue gases.

Another advantage of the slag-tap furnace is its ability to burn the coal completely. Coarse coal can be fed without increasing the combustible loss, as these coarse particles float on the surface of the molten slag until they are consumed. The molten slag constitutes a higher temperature portion of the furnace envelope in the vicinity of the burners, which produces earlier ignition and more complete combustion. There is a combination of burner and furnace arrangement where the flame is directed in such a manner that it impinges on a wall or target and the secondary mixing produced is helpful in completing combustion. This combination is very attractive, but is difficult to apply to refractory walls, due to the high cost of maintenance which would result.

If applied to water-cooled walls, the heat that is absorbed by the tubes is more than they can safely handle and the chilling effect of the wall is harmful. The molten bed of slag, however, provides an ideal target toward which the flame may be directed, and the higher temperature zone produced by this secondary mixing can do no damage. The only precaution that must be taken in the application of this principle is that the burners must be far enough away from the surface of the slag that the tarry matter will be distilled from the coal and only dry particles of coke will impinge against the slag. Fig. 4 illustrates a furnace designed along these lines which is giving remarkably complete combustion, as the flue dust contains less than 1 per cent combustible. As the coal contains 13 per cent ash and only half of the ash is represented in the flue dust, that is equivalent to less than 0.04 of 1 per cent heat loss.

Form of slag

Ash removed in a dry state is difficult to handle and dispose of. It is readily blown from railroad cars and does not make suitable fill, due to its light and powdery form. Disintegrated slag from slag-tap furnaces, on the other hand, can be pumped any convenient distance for fill, or can be loaded into cars for hauling to more dis-

Some Utility Installations Using Slag-Tap Furnaces

Company	Date Slag-Tap Furnace Started	Number of Boilers	Maximum Boiler Output, Pounds per Hour	Furnace Volume, Cubic Feet	Heat Liberation, B.t.u. per Cubic Foot	Coal District	Typical Coal Analysis: Volatile Matter	Fixed Carbon	Ash	Fusing Temperature	Number of Burners per Boiler	Type of Burner	Type of Pulverized Coal System
Buffalo General Electric Company Huntley No. 1	4–26	1	275,000	11,000	38,000	Pittsburgh or northern Pennsylvania	33.33	57.77	8.90	2,310	4	Horizontal cross tube	Direct fired
	12–26	3	275,000	10,358	40,450						4		
	9–28	4	300,000	11,625	37,800						4		
		2	400,000	16,430	35,400						6		
Buffalo General Electric Company Huntley No. 2	10–30	4	560,000	22,900	38,310	Pittsburgh or northern Pennsylvania	33.33	57.77	8.90	2,310	6	Cross tube	Direct fired
Chicago District Electric Generating Company State Line station	6–29	1	450,000	16,700	34,500	Illinois Kincaid	37.21	50.24	12.55	2,090	8	Calumet	Direct fired
	8–30	1	450,000	16,850	34,300						4	Vertical inter-tube	
Deepwater Operating Company	1–30	2	331,000	19,080	22,640	Pennsylvania Indiana Company	26.80	63.42	9.78	2,160	6	Couch	Bin system
		1R	290,000										
	3–30	2	331,000	19,080	22,640						4	Cross tube	Direct fired
		1R	290,000								4	Cross tube	
Jersey Central Power & Light Company	9–30	3	280,000	13,300	27,500	West Virginia	23.70	71.30	5.0	2,400	5	Calumet (2 boilers)	Direct fired
											5	Roe (1 boiler)	
Northern Indiana Public Service Company	1–31	1	345,000	14,700	29,900	Indiana	41.25	47.87	10.88	2,210	4	Cross tube	Direct fired
		2	345,000								8	Kennedy Van Saun	
Ohio River Edison Company		4	300,000	13,800	29,000	Ohio, Belmont Pittsburgh District	37.38	52.10	10.52	2,240	5	Peabody	Bin system
		1	350,000	18,030	25,000						4	Peabody	Bin system
		1	350,000	16,450	27,400						4	Cross tube	Direct fired
		2	350,000	17,000	26,800						4	Cross tube	Direct fired
Oklahoma Gas & Electric Company	11–28	2	250,000	12,900	26,800	Oklahoma, Pittsburgh Company	34.33	51.60	14.07	2,140	4	Calumet	Direct fired
Public Service of Colorado Valmont station	2–30	1	275,000	9,920	38,600	Colorado, Lignite Weld Company	52.15	40.07	7.78	2,170	4	Vertical cross tube	Bin system
Super Power Company of Illinois	7–29	2	275,000	12,440	29,200	Illinois, Sangamon Company	37.75	46.69	15.22	2,025	4	Cross tube	Direct fired
	7–29	1R	200,000	11,380	23,600						4	Cross tube	
	11–30	2	450,000	19,890	28,500						6	Cross tube	
	11–30	1R	290,000	20,460	24,400						6	Cross tube	
	Under construction	2	450,000	19,890	27,500						6	Cross tube	
		1R	290,000	20,460	24,400						6	Cross tube	
United Electric Light & Power Company, Hellgate station	10–30	2	800,000	42,500	26,200	West Virginia, Pocahontas	21.59	73.36	5.05	2,400	12	Cross tube	Direct fired
Waukegan Generating Company	5–30	2	300,000	14,727	26,000	Illinois, Vermilion Company	35.90	51.70	12.40	2,250	6	Calumet	Direct fired
	6–30	1R	178,000	14,727	21,400						6	Calumet	Direct fired
		2	495,000	24,100	26,200						6	Cross tube	Direct fired
		1R	300,000	24,100	20,750						6	Cross tube	Direct fired
Wisconsin Power & Light Company, Sheboygan		2	300,000	10,600	36,800	Pennsylvania, Pittsburgh District	32.75	55.78	9.53	2,300	4	Vertical cross tube	Direct fired
Total		67	22,592,000										

tant points, with the same ease as coarse sand is handled, and forms the same type of satisfactory fill.

With vast tonnages of coal that have fusing temperatures below 2,500 deg. F. available in practically all coal regions, the use of fluxes will not be required except in unusual instances, and then only as a local flux.

It is not necessary to have a boiler operating at high rating to tap slag, as units operating at one-third of their maximum rating are being tapped easily. Where two rows of burners are installed, one above the other,

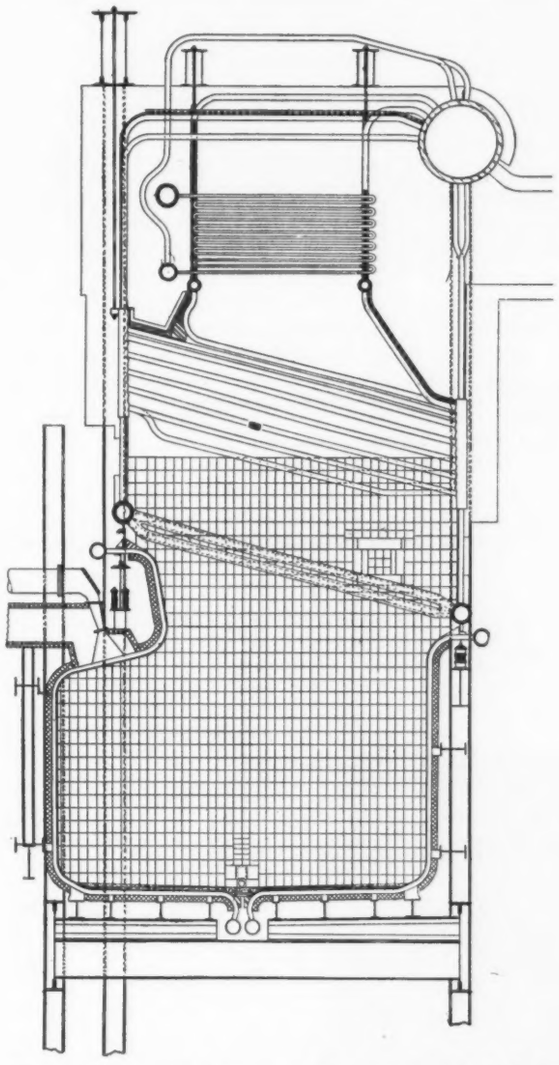


Fig. 4—Slag-tap furnace with water-cooled floor and burners directed against floor

difficulty has sometimes been experienced in tapping, when only the upper row was in service. With only the lower row in service no difficulty was experienced.

Coal ash or slag at a temperature of 2,500 deg. F. or higher erodes or penetrates practically any refractory at a very rapid rate. The only way it can be retained is by cooling or freezing. Most of the earlier installations had a dolomite floor as illustrated in Fig. 5. A number of floors of this construction have been in service more than three years without trouble, but some others have been dug up along the edge once or twice in order to relieve the floor of the accumulated "growth." On the

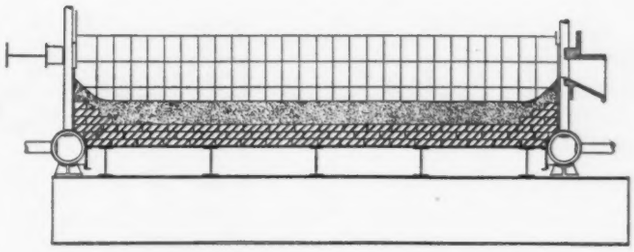


Fig. 5—Uncooled refractory floor using dolomite fill above brick

other hand, the "growth" on some floors has been very rapid and it has been found that these floors contained appreciable amounts of iron sulphide (FeS), which is very fluid at temperatures as low as 1,750 deg. F. and flows very readily into cracks and porous materials. Particles of pyrites are heavy and often sink into the slag and may be sealed from air and converted to iron sulphide (FeS).

The water-cooled floor shown in Fig. 6 was developed to meet these conditions. Smooth iron blocks are mounted in close thermal contact with the tubes and the joints between blocks carefully sealed with chrome cement, which provides a liquid-tight floor that also supplies sufficient cooling to freeze the slag immediately above the blocks. The total thickness of slag can then be reduced to a few inches, as compared with 1½ to 2 ft. for uncooled dolomite floors. This bed of slag is so thin that trouble from growth is not experienced.

The water-cooled floor has the further advantage that the loss by radiation from the bottom of the floor is no more than from the side walls of the furnace, which, with proper insulation, is very small. The amount of slag in the furnace is so small that it cools quickly when the furnace is shut down, and the furnace can be entered within ten to twelve hours.

The amount of heat absorbed by the cooling tubes in the floor is also quite small, due to the insulation of the slag on the blocks. Not more than 5,000 B.t.u. per square foot per hour is absorbed. This very low rate of heat absorption permits the installation of these tubes on a very light slope without danger of overheating. This water-cooled floor also makes it possible to tap out the iron sulphide that may collect, instead of allowing it to accumulate on the floor.

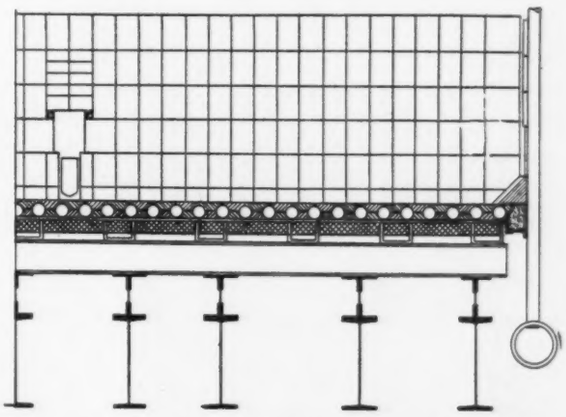


Fig. 6—Water-cooled floor using cast-iron blocks clamped to cooling tubes

Lighting Prime Source of Theater Decoration

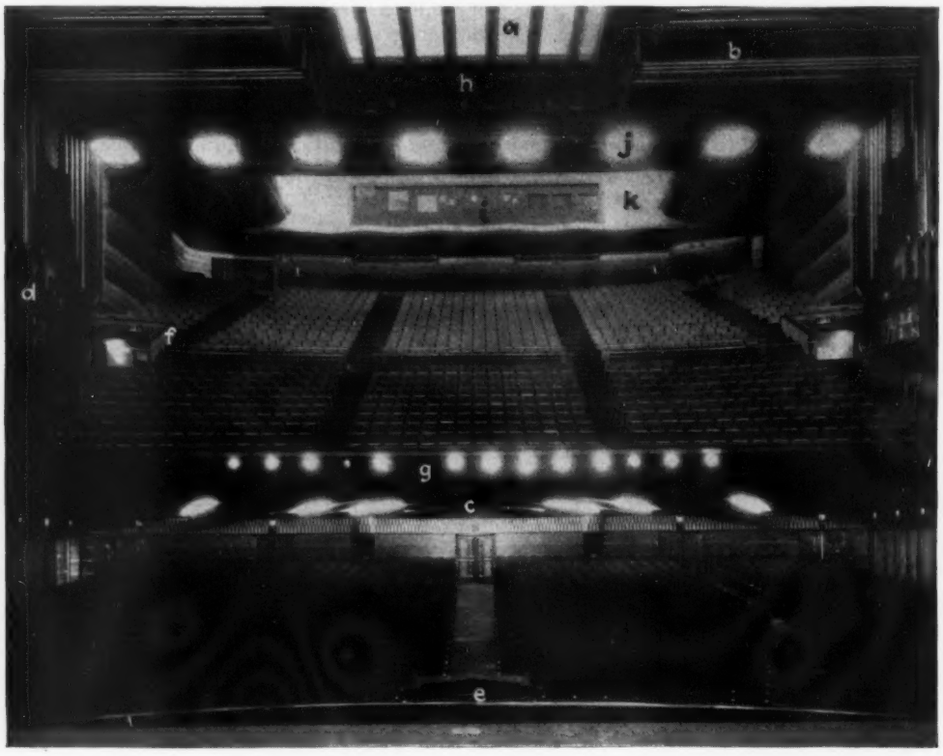
By EUGENE CLUTE

COMPREHENSIVE and almost exclusive use of light sources to secure distinctive mural decoration as an adjunct of effective illumination has been carried to a high degree in the new Earl Carroll Theater in New York City. Other innovations are the provision of four-color light circuits for tonal effects in auditorium as well as on the stage. All lighting circuits are controlled from a console station in a pit between the auditorium and the stage, thus giving the lighting conductor a significance comparable to that of the musical director. Light sources in three different regions of the auditorium make footlights unnecessary.

The treatment of light in the entrance lobby, stairways, mezzanine, ladies' room and elsewhere also makes light the principal source of ornamentation. There are only two visible light sources in the auditorium and few elsewhere except in the mezzanine lobby, where a limited number of ornamental floor lamps is employed. Flashlights are inserted in the backs of all orchestra seats so that the audience may read its programs when there is no general illumination.

In general, the auditorium wall area is covered with black velvet. Nickel-chrome steel is used for the frame of the lighting recesses in walls and ceiling. Aluminum paint and soft white surfaces lend an element of contrast to the dark wall areas. A touch of color is introduced by three shades of coral used on the sides of the boxes and on the panels of the vomitory lights as well as on the curtain. Seat upholstery is also dark coral.

Incandescent lamp wattage in the 34 circuits on the stage amounts to 231,000 watts; for the nineteen auditorium circuits it amounts to 136,000 watts. This total of 367,000 watts is exclusive of arcs and projection



Auditorium embraces many lighting innovations

(a and b) Panel lighting on ceiling and side walls. (Details on page 963.)

(c) Underside of balcony lighted with full eye-comfort to audience. (Page 963.)

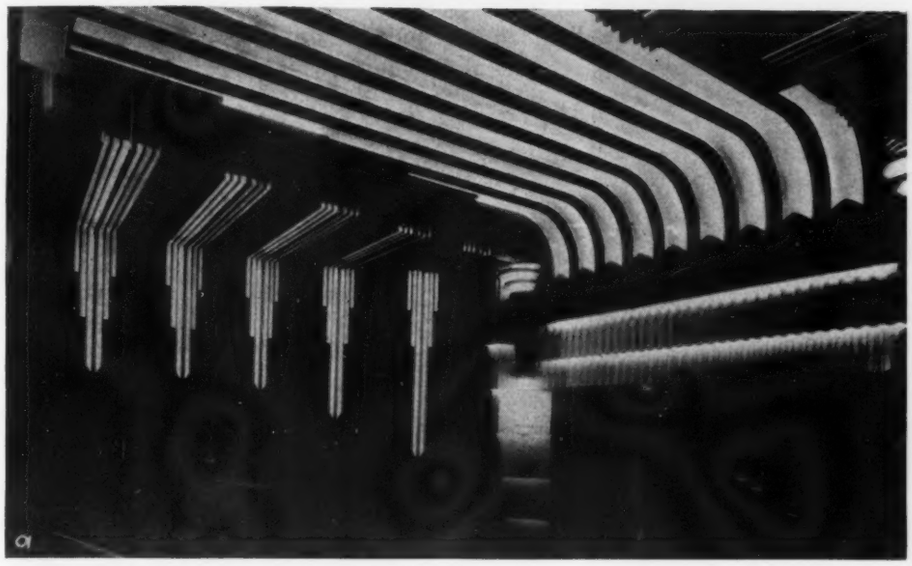
(d) Soffits located under boxes illuminate the side aisle seats. (Details on page 964.)

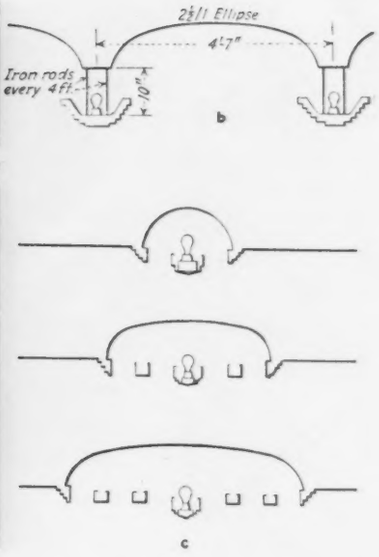
(e) Light control console concealed from audience gives lighting director full view of the effects he establishes on the stage. (Page 964.)

(f) Vomitory lighting introduces decoration along with effective illumination. (Page 965.)

(g, h, i) Floodlights in facia of balcony, in arc room above balcony and in projection booth make footlights unnecessary.

(j, k) Soffits under main ceiling beam which houses arc room and cove lighting from rectangular well behind it illuminate balcony area.





lights for spot- and flood-lighting of the stage from the auditorium locations mentioned.

Joseph J. Babolnay designed the theater and the lighting in co-operation with the architect, George Keister. The "Thyratron" dimming control was especially designed for this theater by the General Electric Company. Cove stripping was furnished by the Rehn Stage Lighting Corporation and the lighting fixtures, other than built-in lighting, by Bayley & Sons. Fischbach & Moore were the electrical contractors. The rehearsal jack system, whereby the owner or director can communicate from his seat in the auditorium or from almost any point in the house with the stage managers, lighting director, orchestra leader, projection room, etc., was installed by the North Electric Company.

(Other views on two following pages)

Underside of balcony lighted with curved overlapping coves

(a) Coves arranged in sectors which throw all light forward or toward the side. Soffits white near the coves, shading into gray, give effect of alternate bands of lighting contrast. Fresh air is admitted through ducts opening into the coved recesses, where hidden lights are installed.

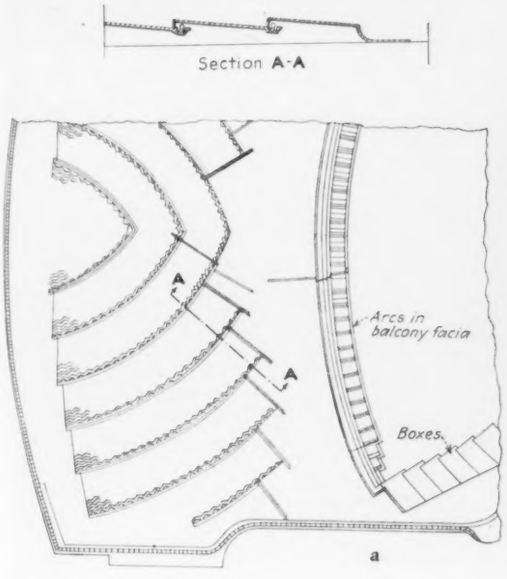
(b) Soffits sloped to provide depth for coves, which are so curved that the light does not shine in the eyes of any rear-orchestra spectator facing the stage. A program light is seen in the back of each seat.

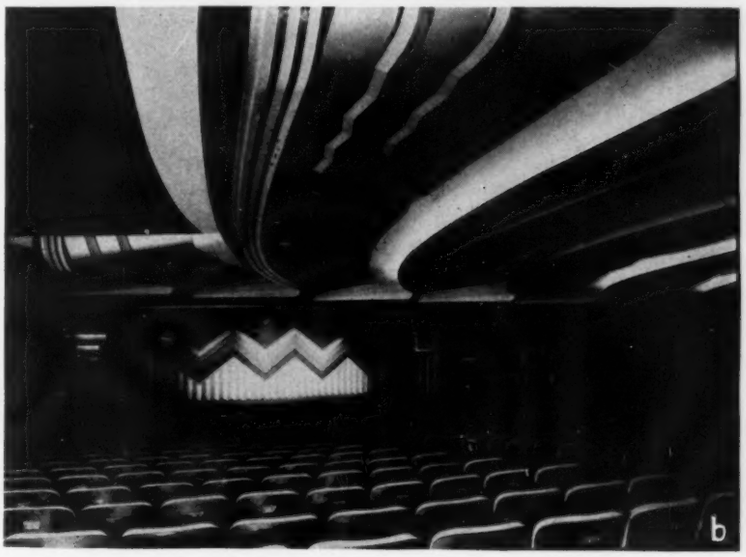
Bands of reflected light on ceiling and side walls

(a) The center of the auditorium ceiling is banded longitudinally with coved recesses each about 4 ft. wide and 70 ft. long. They curve down to the top of the proscenium arch. The surfaces are of plaster with aluminum paint for soft diffusion. Lateral bands extend to and down the side walls, terminating in banner points.

(b) Elliptical surfaces illuminated by lamps in trough suspended by rods from ceiling ribs. Here, as elsewhere in auditorium coves, the sockets are on 3-in. centers with 10-watt white, 15-watt green, 15-watt red and 25-watt blue bulbs in sequence.

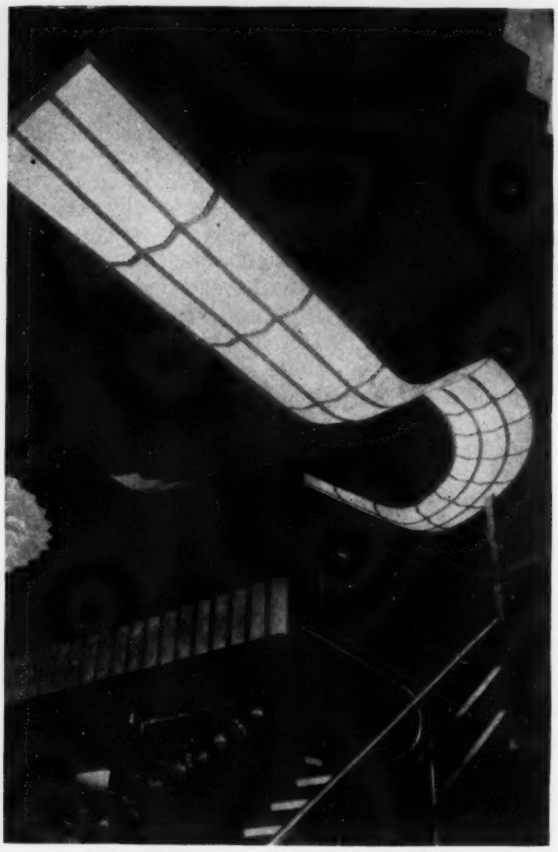
(c) On the side walls the bands have lights only in the center trough. The others (first four, then two and at the bottom none) are dummies to create the silhouette effect.





Lighting conductor controls all stage and auditorium circuits

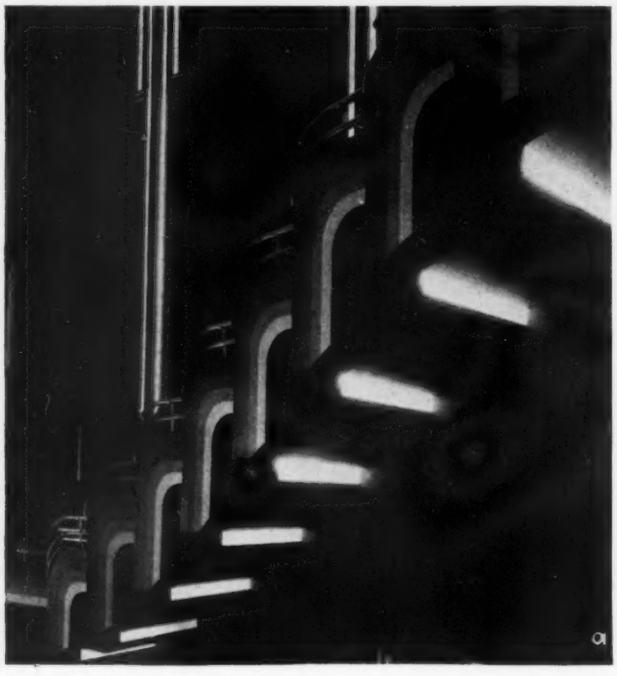
Six high-power arc floodlights and two arc spots in arc room at ceiling can be blacked out by dimmer control at console station; likewise, projectors and floods in projection room at rear of balcony and floods in balcony facia. "Thyratron" tube control with saturable reactor cores governs impedance drop in series with lights for continuous gradation of dimming of all colors. Four-watt control circuits suffice for the manipulation of each of the 53 dimmable circuits on stage and about auditorium.

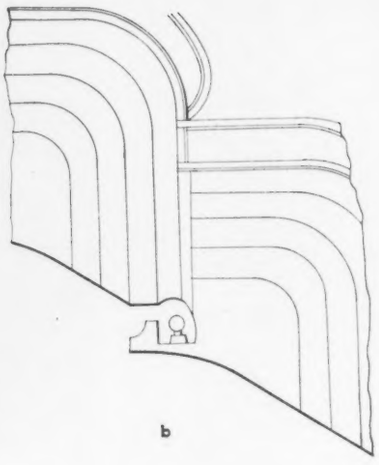


Band of ceiling light winds over stairway

Ceiling is black either side of soffit which centers over the stairway. In the lower left-hand corner can be seen part of an inverted ceiling cone which illuminates one of the portals to the orchestra.

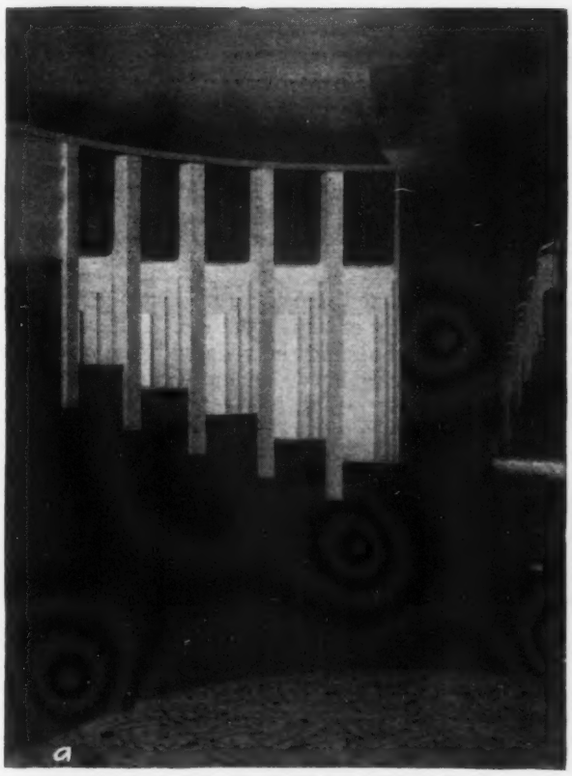
Balcony side seats illuminated by coves under boxes





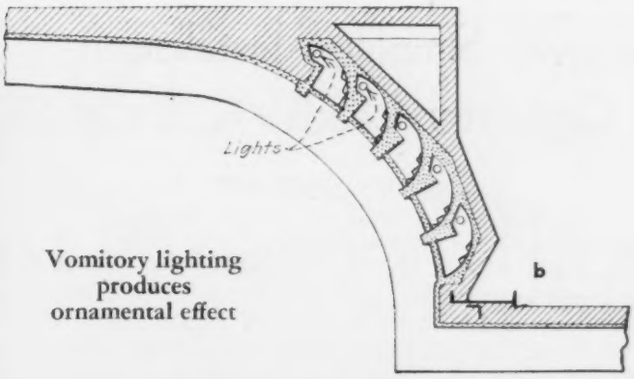
(a) Boxes, cantilevered from the side walls, have recessed cove lights which shine on plastered soffits under each step of the box tier.

(b) Concealed lights, illuminating diffusing surfaces of coves, throw no glare in the eyes of spectators at any seat level under the boxes.

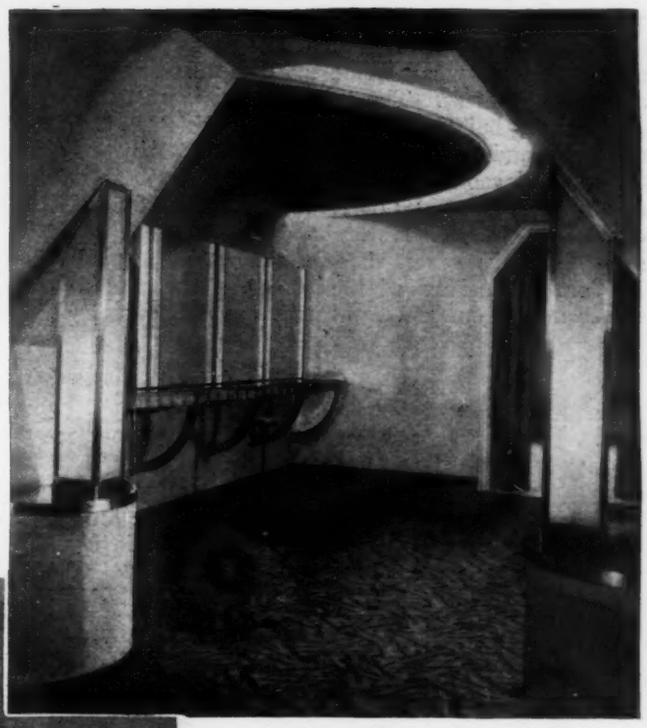


(a) Concealed lights in curve of vomitory, entering mid-balcony level, illuminate stepped white and coral surfaces in artistic pattern. Box tier visible through the portal.

(b) Serrated recesses in vomitory curve hide light sources. Easily relamped.

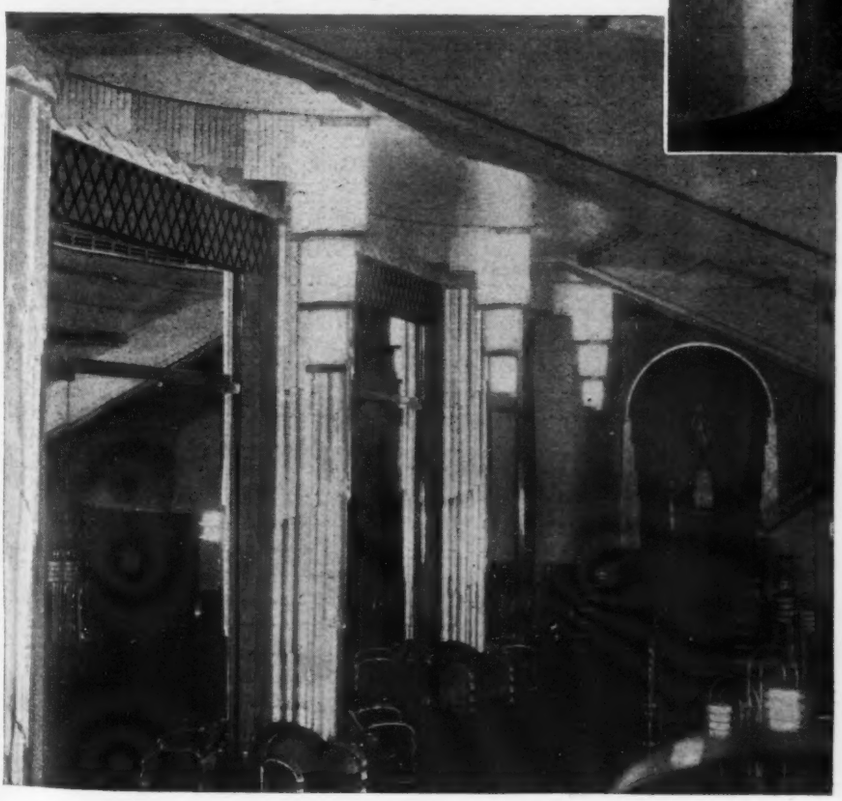


Vomitory lighting produces ornamental effect



Unique lighting scheme in ladies' room

Semi-circular ceiling cove gives soft radiant brilliance. Lamps in recesses between mirrors afford effective light distribution with no annoying glare in the line of vision. Structural impediments turned to ornamental account by column units with ground glass inclosure.



Pendants and floor units in mezzanine lobby

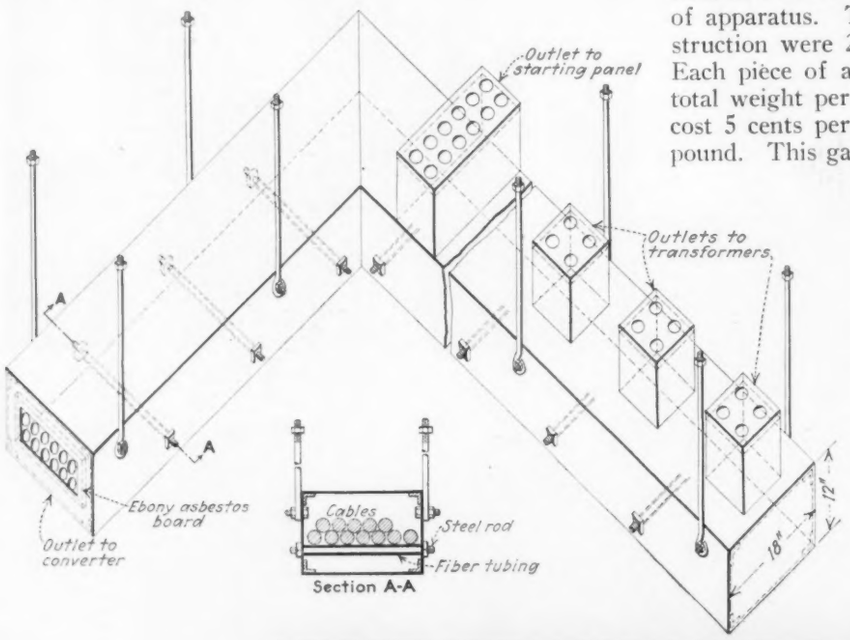
Lantern type ceiling fixtures are diamond shape in section and are skirted with stepped glass plates running in arc to the wall behind them. Nickel-chrome steel floor standards of lantern type are wrought with motifs of musical symbols.

Raceway Simplifies Installation of Converter Leads

By SIDNEY WATKINS
Electrical Engineer Warner & Swasey Company, Cleveland, Ohio

At a cost less than was estimated for standard conduit construction, and with no sacrifice of appearance or in the quality of the job, the problem of installing runs of heavy leads between supply transformers and two new rotary converters was solved in the plant of the Warner & Swasey Company, Cleveland, Ohio. The two converters, one 500 kva. and the other 300 kva., were installed in a corner of the power house, in a rather restricted place which made the disposition of the leads somewhat difficult. The transformers were installed in an adjoining building. The connection between the larger converter and the transformer consists of fifteen 1,000,000-circ.mil cables, while the connection to the smaller one includes six cables of 1,000,000 circ.mil each and six of 500,000 circ.mil. Naturally the leads of one converter are kept separate from those of the other.

From the ceiling of the basement under each converter a sheet-metal box or raceway was suspended by means of $\frac{3}{4}$-in. iron rods spaced 3 ft. apart. This raceway was run from the converter to the starting panel and then on to the transformers. The outlets were all bushed with ebony asbestos board with holes for the individual cables. Each raceway was made of No. 10 gage sheet steel, and the dimensions were as shown on the drawing. The open side faced downward, and the cables were supported in the raceway by $\frac{3}{4}$-in. rods passed through the box about 3 in. from the bottom. These rods are covered by fiber tubing. Special care was taken to see that there were no sharp edges at the turns in the raceway or at the outlets. After the cables were placed in the box and the rods with the fiber tubing were all in place the lower cover was fastened on by screws.



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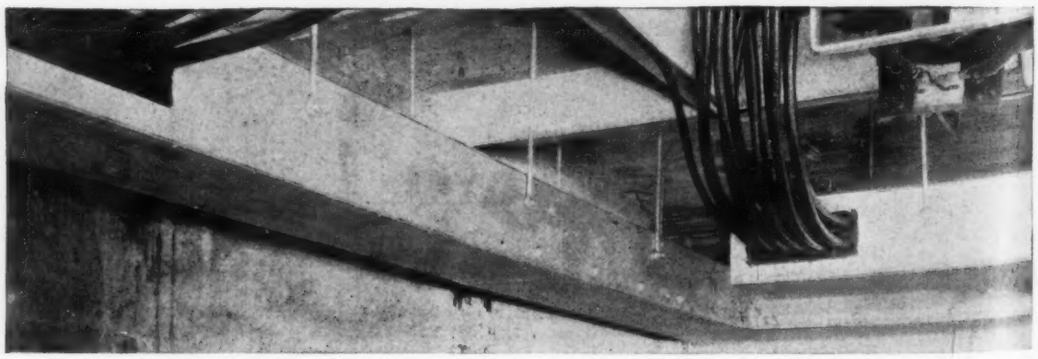
Electric Welding Saves 30 per Cent of Job Cost

"To convince himself that electric welding was less expensive than a corresponding casting, a large manufacturer made a test of the two methods on a considerable scale," stated C. L. Ipsen of the General Electric Company at a recent meeting of the Associated Industries of Massachusetts. "The order called for two pieces of apparatus. The over-all dimensions of the cast construction were 21 ft. long x 10 ft. wide x 10 ft. high. Each piece of apparatus consisted of two parts, with a total weight per piece of 79,485 lb., of which 54,315 lb. cost 5 cents per pound and 25,170 lb. cost 10 cents per pound. This gave a total cost for one unit of $5,232.75. The patterns for this unit cost $2,000. The total cost of the cast construction was $12,465.50 including the patterns and the total weight was 158,970 lb.

"Comparing the cost of welding, the two units were electrically welded at a total cost of $8,762 and the weight of the welded construction was 126,000 lb. The saving in money amounted to $3,703.50, while the saving in weight was 32,970 lb. This saving was about 30 per cent of the cost of the cast job."



Raceways for converter leads save money

Interpret Anti-Trust Laws; Don't Abandon Them

BY WILLIAM S. DONOVAN*
Formerly Assistant Attorney-General of the United States

Existing anti-trust legislation is charged by many with prolonging the depression. There are those who would abandon the Sherman and Clayton acts. Mr. Donovan, eminently qualified to express judgment in the matter, here states his reasons why any plan to modify this legislation should be very carefully weighed, unless we want more and more government regulation of business.

THE Sherman act reflects the old common law theory that competition will prevent the evils flowing from monopoly. It assumes that the maximum economic production and distribution of goods can be secured by the free play of competitive forces. We have come to recognize, however, that this concept is not always self-operative and we have insured its continued action by passing further restrictive and regulatory laws. Such legislation represents an effort on the part of the state to establish its own rules of competition and to fortify the competitive system by dealing with specific abuses as they arise.

Of late years we have adopted legislation which appears to limit the universal application of the competitive principle. As illustrative of this trend one may cite utilities which operate as monopolies under governmental supervision, the widening category of business which has been legislatively declared and judicially found to be affected with a public interest and the present tendency of the state to participate in business of public and private nature. As a corollary to this we find the consumer and the wage earner more and more reluctant blindly to place faith in a philosophy of individualism based on conditions which they assert are unsound or no longer exist. More and more the consumer and the wage earner look to the government for protection. We are beginning to witness a steadily growing tendency of industry itself to abandon its position of independence of governmental control and, by calling for the eliminition of restrictive measures such as the Sherman act, to demand, in effect, that government shall impose upon it some kind of regulation.

State versus industry

Industry may not recognize that, if the theory which the Sherman act embodies is to be completely abandoned, the only alternative will be that industry must submit to some kind of regulatory measures. The history of our economic system suggests, however, that we have a choice between those restrictive laws which limit the field in which industry can freely operate and regulatory measures which, while enlarging the field of operation, will impose close governmental supervision and control.

The problem of reconciling the interests of the state with the interests of great industrial organizations constitutes a challenge to our ability to govern ourselves. We have reached a maturity in our industrial life where its complexity and the all-embracing and vital part which it plays in our social and economic well-being demand that we re-examine the basic philosophy upon which all effective regulation of industry must depend. The concept that the interests of the state and those of the managers of private enterprise are in conflict has been developing for nearly half a century. There has been ample opportunity to observe its workings. Today we find a widespread feeling that the fundamental point of view of both the government and the managers of private enterprise in the enforcement and application of these laws need not be wholly divergent. There are those who assert that the laws dealing with the control of business are not sufficiently stringent and effective and a movement is on foot to extend to the fullest, if not governmental ownership, at any rate, the closest kind of governmental regulation.

On the other hand, we find a growing demand on the part of industry that it should be freed from the trammels of government and permitted to work out its destiny unhampered. The language of the Sherman act has been criticised as being so broad and so general that no one can say exactly what activities will be found to be in violation of the law. It has been suggested that the act should be amended so as to contain a specific enumeration of specific offenses which would be punishable under the law. However, such a plan would be ineffective. It is impossible to predict every scheme and device which may be employed in the future to accomplish results which the act seeks to prevent and any pro-

*From address before National Conference on Relation of Law and Business, New York University.

hibition of specific activities could be avoided by an astute lawyer. The Supreme Court has said that the language of the Sherman act is sufficiently broad to include "every conceivable act which could possibly come within the spirit or purpose of the prohibitions of the law, without regard to the garb in which such acts were clothed."

The Sherman act has been applied and interpreted by the courts under many varying states of fact, and it has come to have a more certain meaning than it would have if a proposal for amending the act were adopted.

The act has been blamed for our inability to work out certain problems which have been accentuated by the present depression. An outstanding example of this is the difficulty encountered by certain industries in meeting the problem of overproduction. However, the history of anti-trust prosecutions since the enactment of the Sherman act in 1890 shows that in periods of depression, and immediately thereafter, the number of prosecutions for violations of the law have greatly increased, but that when prosperity has returned and industry has less need for resorting to the old methods of monopoly and restraint the number of prosecutions has decreased. The truth would seem to be, not that the Sherman act has been one of the factors causing a depression, but that when the depression has come each particular industry, in casting about for some remedy for the crisis, finds that the Sherman act prohibits the adoption of methods which centuries of experience have taught us to believe are contrary to the general public welfare.

Abandon anti-trust laws?

Some may feel that it is now time to discard principles evolved from centuries of experience in trade and to give legal sanction to monopolies and agreements in restraint of trade, whether in the form of agreements to limit production, or price fixing or otherwise.

The consequences of such a course should be fully recognized before it is adopted. Unregulated and uncontrolled operation of industries under conditions of monopoly is antagonistic to the whole trend and course of our social development. In every instance where such conditions exist the industry has been subjected to rigorous governmental supervision and control. Examples may be found in the close governmental supervision exercised over railroads and public utilities.

The historic fact that we have had to face in the whole problem of regulation of private industry is this: Where a condition of monopoly exists, and there is no governmental regulation, agreements between private interests tend to become onerous and to burden unduly not only the particular industry but the public as well. Industry, therefore, cannot hope for modification of the anti-trust laws to permit monopolistic practices, unless such practices are attended by closer governmental supervision or participation than exists today. If, therefore, industry desires to modify the substantive provision of the Sherman act it should frankly recognize that industry would be subjected to closer governmental supervision and control.

Rush C. Butler will, I understand, present a proposed amendment to the anti-trust laws. I have had the opportunity to consider this statute. As I understand it, it confers on the Federal Trade Commission the power to determine whether or not a proposed contract or agreement submitted by the parties thereto "so lessens competition as to be against the public interest or tends to create a monopoly." The test set up in this statute is different from the test applied by the courts to interpret the Sherman act in proceedings brought by the Attorney-General.

The difficulty I find with this statute is that industry will have to meet not only the present-day tests of legality as laid down by the courts, but also this new test. If, for example, the Federal Trade Commission should find that the proposed contract or agreement is legal under this new test, it seems to me that this conclusion has little practical value to industry because, necessarily, this finding can only be *prima facie* evidence of the fact that performance of the contract "will not so lessen competition as to be against the public interest or tend to create a monopoly."

If the Attorney-General should disagree with the Federal Trade Commission and should conclude that, while the proposed contract might be proper under the test of the new statute, it was nevertheless in violation of the anti-trust laws, and should institute proceedings against the parties, the findings of the commission would not necessarily be material to the issues before the court. Of course, if the Attorney-General brings a charge of monopoly against a corporation or group the findings of the commission that the practices "do not attempt to create a monopoly" would be material, but I assume that the great bulk of the hearings before the commission under this statute would involve other matters.

There is a further difficulty that the proposed new test raises the question as to the constitutionality of the statute. I am not prepared to discuss this in any detail at the present time, but certainly the phrase "so lessen competition as to be against public interest" does raise this question.

If the objections which I have mentioned have any force the statute can be readily changed to meet them by providing that the test to be applied by the Federal Trade Commission shall be whether or not the performance of the contract is in violation of the anti-trust laws.

The statute as it stands now does not attempt to amend the anti-trust laws, and, in the event that the Attorney-General should disagree with the conclusions reached by the commission, industry must still face the ultimate question as to whether its action does or does not violate those laws. In any event, the finding by the commission that the proposed action does or does not violate the anti-trust laws would be of real value to industry because it is a finding on the ultimate question.

To improve anti-trust laws

My own view is that a most important element in the enforcement of the anti-trust laws lies in the theory and method of administering these laws. There are measures that could be adopted, not fundamental in their nature, but which would enable industry to know better what it could properly do in a given circumstance without the fear or threat of criminal process.

I, of course, can speak only from my own experience. In the Coolidge Administration a definite policy was adhered to of giving opinions in advance concerning proposals which might come within the prohibitions of the law. It was felt that the purpose of the law was to prevent the organization of combinations and agreements that might be violative of the law, and that the most effective way to deal with such activities and to protect the public was to prevent their coming into being and

not to wait until they had actually been effected and worked their harm.

Various methods have been suggested by which the administration of our anti-trust laws may be improved. But whatever plan is adopted, it would seem that the following features must be included. Some federal agency, such as the Federal Trade Commission, should be vested with advisory and quasi-judicial powers. Only the Attorney-General should have authority to institute proceedings to restrain and prevent violations of the law. Except in criminal cases, all proceedings instituted by the Attorney-General and all private litigations for injuries resulting from unfair competition should be brought before this commission. A review of the decisions of the commission could be had either by the Circuit Court of Appeals or perhaps by a specially constituted court.

Parties entering into agreements affecting interstate commerce should be given the right to submit such agreements to the commission, which should be authorized and directed to give advisory opinions in matters involving the public interest. Such opinions should constitute *prima facie* evidence in any subsequent civil proceedings involving the same facts and should prevent criminal prosecution by the government.

It is undoubtedly true that the great and fundamental changes that have taken place in industry in the last fifteen years have forced us to a reconsideration of the fundamental wisdom of the anti-trust statute, but the fact that conditions have changed, that new business methods have been evolved, that it is recognized that unrestricted competition presents evils that may be dangerous to society should first of all call for investigation of the true interpretation of the prohibitions of the statute. The statute in general declares that any agreement or contract which injures the public by restraining trade is unlawful. In the final analysis when this statute is to be construed, it must be construed within the limits of that principle. During the past 40 years the cases that have been submitted to the final judgment of the Supreme Court have been cases wherein, generally, it has been clear that the object sought to be attained by the agreement or the merger was the exploitation of the public, but it might very will be that in times of an industrial depression an agreement which under normal conditions is illegal may become purely defensive in its purpose and effect and, therefore, in the public interest. Conditions, agreements, understandings held to be unreasonable under the old order might very properly and very wisely be held reasonable under the new.

What we ought to see is whether or not this statute, in the light of interpretations of the court, is resilient enough to be responsive to changing conditions. No one believes that the Sherman act was designated to destroy industry. No one asserts that it was the purpose of the Congress or the aim of the courts to cause economic waste and to precipitate industrial chaos and disaster. It may be true that there are decisions which in their general expressions have gone beyond the need in dealing with the particular state of facts presented to the court.

We have not yet devised an economic system to replace the principle of free competition, which will adequately protect the public from the dangers of monopoly without undue governmental supervision and regulation of industry. Until we are prepared to abandon the competitive principle, the anti-trust laws must remain to prevent abuses which, if unchecked, would destroy that principle and substitute monopoly, with all its attendant evils.

The adminstration of the anti-trust laws, however, can and should be changed, so as more nearly to conform to the purpose for which they were enacted. That purpose was not to conduct a series of raids upon industry, but to insure that industry would conform to certain standards of business conduct. It must be recognized that efficiency and economy in industry can only be attained by full opportunity for the legitimate growth and consolidation of business units and that inherently there should

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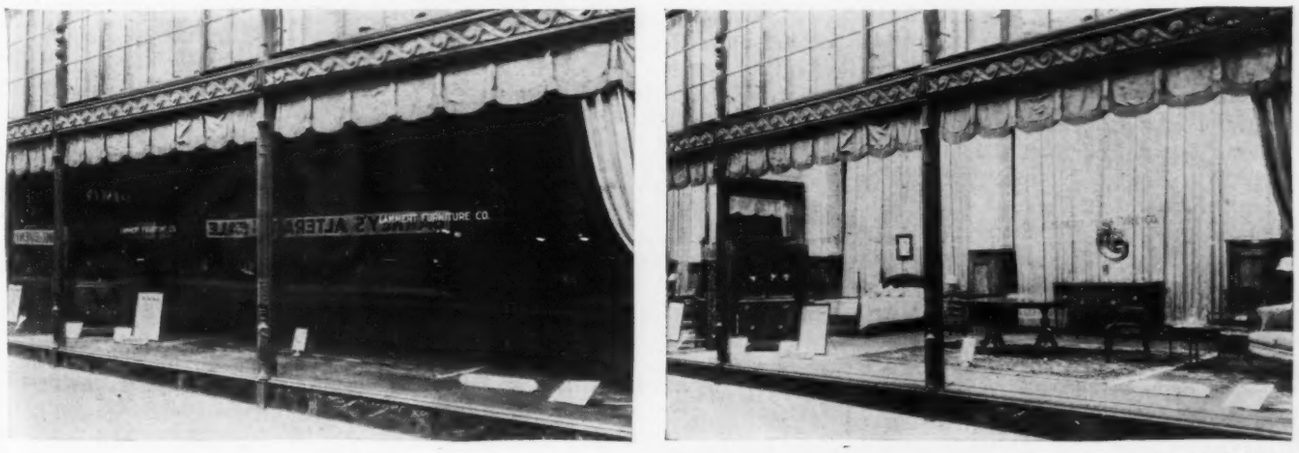
Show-Window Lighting Needed in Daytime



Curtis Lighting, Inc.

At the left is cause for reflection on the part of both the show window and its owner. This excellent advertisement of a sale across the street is really intended to be a display of furniture. At the right observe how high-intensity illumination offsets the reflections by equalizing the outside daylight.

be no conflict between legitimate business and government.

Business too often is shackled by a fear that prevents it from attempting measures legitimate in themselves, but which have not been passed upon by the courts. Industry should not submit to a counsel of despair or of futility and fly to the bosom of government for relief. If it believes that a particular measure of defense is economically sound and right, then let it take its position and submit to the decisions of the court. The court is alive to changing conditions, and it is only by the advance to new ground that the law can be interpreted and developed in meeting the needs of our changing industrial civilization.

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READERS' FORUM

Condensation Causes Flashovers

To the Editor of the ELECTRICAL WORLD:

Interruptions on transmission lines at sunrise are not a new phenomena. They occurred on the first steel tower line. This was put in service by the Guanajuato Power Company in Mexico in 1903. During the fall months of 1904 and 1905 insulators would often flash over at sunrise, for they would be covered with a thick layer of condensed moisture for a few minutes at that time of day. This trouble was overcome by the use of larger and better-designed insulators. The characteristics of the line and the tests made to determine the cause of interruptions are as follows:

Length, miles	103
Voltage	60,000
Transformers	Star high-tension neutral grounded.
Conductor	19 strand Cu. equivalent No. 1 B. & S.
Supporting structures	Aermotor steel towers, channel iron crossarms.
Insulators	Three-part pin type Locke No. 329, diameter top 14 in., height 12 in.
Pins	Steel castings.

It will be noted that the insulators were mounted on an all-steel structure, so they had to withstand the full voltage.

The line was put in service at full voltage in February, 1904. During the rainy season, which corresponds to the summer months, there were a number of interruptions due to lightning. Then, when the rains were over and there was no further trouble from lightning, interruptions began to occur just at sunrise. Nearly every morning there would be a ground on the line and a conductor would be burned off at the insulator if the ground did not clear promptly.

We had the bird, the shooting, the men-going-to-work theories, but they all established alibis. Our men discovered, however, that the insulators became covered with a thick layer of condensed moisture just at sunrise and noted some leakage, but they never saw an insulator flashover. To explain our trouble as due to flashover it would have to occur at a voltage of approximately 36,000 when operating at 60,000 volts, and our insulators had stood up under 85,000 on rain tests. However, we started testing the insulators under conditions as nearly approaching those occurring on the line as possible.

The coldest time of day is just before sunrise. When the sun comes up the temperature rises quickly and a cold mass of porcelain and steel will act as a condenser and become covered with a layer of moisture. The thickness of this layer will depend upon the change of temperature, the saturation of the air and the condenser. The atmosphere, just after the rainy season, was near the saturation point and the sun, at our latitude in the tropics, rose quickly. These conditions all favored condensation. We tried to duplicate them by exposing the insulators to the temperature of the generating room after they had been packed in ice for some time (no salt was used with the ice). The insulators so treated became covered with a layer of condensed moisture, corresponding to the moisture on the line insulators at sunrise. When tested they flashed over at approximately 35,000 volts, thereby proving that our trouble was due to insulator flashover. However, this is not all the story.

I made similar condensation tests at the Locke factory (Victor, N. Y.) and could not flash the insulators over below 60,000 volts. In Mexico the altitude was 5,000 ft., in Victor about 500 ft., but this was not nearly enough difference to explain the discrepancy. At the Locke plant, however, we only had 70 kw. back of the test, while in Mexico we had 1,500 kw. in waterwheel, generator and service transformer capacity, and it is to this factor that I ascribe the great difference in flashover.

We would bring the voltage up on the insulator until leakage was noticed, then hold it steady. The streamers of leakage gradually spread until, in a minute or two, the insulator flashed over. Then we would again test the insulator. This time the leakage would start at a lower voltage and a lower flashover would result. The low limit of flashover would occur after several such tests, when the insulator was apparently free from condensation and slightly warm. I contend that at first the condensation was in drops and later it was in a thin continuous layer. We could detect no nitric acid by the use of litmus paper.

Rain tests do not give a proper basis for determining the flashover, for condensation and fog produce more severe conditions than rain, and nearly all transmission lines are at times subjected to fog or condensation conditions. Condensation tests show the value of insulators to withstand fog as well as condensation and should be made to determine the flashover value of insulators.

I believe that the amount of power back of the system is a very important factor in flashover, so that an insulator that could be used on a small system would not be satisfactory on a large one.

The insulators on the Guanajuato line were replaced by larger and better-designed ones of the pin type and a grounded cable was strung over the conductors as a protection against lightning. Since then the line has given nearly perfect service.

In connection with our studies of the line trouble a system of line insulation, using suspension insulators, was worked out by me and it would have been incorporated in our line changes had it been feasible to adapt it to the existing towers. Two years later, in 1907, Curtis and Hine, joint managers of the Guanajuato Power Company, made use of the system on transmission lines in Mexico and Colorado for the first time.

NORMAN ROWE.

Upper Montclair, N. J.

Men of the Industry

A. W. THOMPSON, who for the past five years has been Pacific Coast manager in charge of sales for Fairbanks, Morse & Company, has been appointed vice-president in charge of manufacturing. He succeeds Mr. Heath, who resigned November 1.

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DAN RYAN was elected assistant secretary and assistant treasurer of the Oklahoma Gas & Electric Company at a special meeting of the board of directors called to fill the vacancy caused by the resignation of F. D. Schaefer. Mr. Ryan's election to this position will not change his present duties as assistant to the secretary and general auditor. He has been associated with the company activities for fourteen years in Enid, Sapulpa, Muskogee, Fort Smith and Oklahoma City.

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HARRY SLOAN, advisory engineer with the Vilter Manufacturing Company, has been elected president of the Engineers' Society of Milwaukee. A graduate of Cornell University, Mr. Sloan spent several years in railroad electrification work and then transferred his activities to refrigerating engineering, working with consulting engineers in New York. It was in 1914 that he joined the Vilter Manufacturing Company. He has been active in engineering society activities, holding different offices in the American Society of Refrigerating Engineers and was its president in 1922. Later he was vice-president of the American Institute of Refrigeration.

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DR. M. LUCKIESH, director of the Lighting Research Laboratory, and E. W. COMMERY, residence lighting engineer, both of the Nela Park engineering department of the General Electric Company, will attend President Hoover's Conference on Home Building and Home Ownership, which will be held December 2 to 5 in Washington, D. C. These well-known lighting men are members of the committee on fundamental equipment, headed by Prof. Collins P. Bliss, dean of the College of Engineering of New York University. Dr. Luckiesh is chairman and Mr. Commery advisory member of the subcommittee on electric lighting and wiring. Other members of this subcommittee are Prof. M. L. Nichols of Alabama Polytechnic Institute, Robert T. Jones, technical director of the Architects' Small House Service Bureau, and Roy A. Palmer, lighting engineer of the Southern Public Utilities Company. At the conference Dr. Luckiesh and Mr. Commery will present a comprehensive report on the types and kinds of lighting and wiring best suited to the homes of today.

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W. J. Benning Vice-President of Colorado Utility

W. J. BENNING, who was elected vice-president and treasurer of the Southern Colorado Power Company, as announced in the November 7 issue of the ELECTRICAL WORLD, has served as the general auditor of that company since the fall of 1923. He received his education in the public schools of

Boone, Iowa, and Leadville, Colo., and through various accounting correspondence schools.

Mr. Benning entered the service of the Pueblo & Suburban Traction & Lighting Company, predecessor of the Southern Colorado Power Company, in 1906 in the capacity of timekeeper. He occupied the position of assistant auditor before his appointment as general auditor of the Southern Colorado utility.

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KALMAN J. DE JUHASZ, assistant professor of engineering research, Pennsylvania State College, State College, Pa., has been made the recipient of the Rudolf Diesel award for 1931 for his paper entitled "Dispersion of Sprays in Solid Injection Oil Engines," presented at the national meeting of the oil and gas power division, A.S.M.E., held last June at the University of Wisconsin. Presentation of the certificate of the award, together with the accompanying prize of $100 donated by the Diesel Engine Manufacturers' Association, will be made at the annual meeting of the American Society of Mechanical Engineers in December. The previous announcement, appearing in the ELECTRICAL WORLD (November 7 issue) that Edgar J. Kates was the recipient, was made in error.

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OBITUARY

H. B. Flowers

HERBERT B. FLOWERS, prominently identified with the public utility industry for a number of years, committed suicide in Baltimore, November 24. Mr. Flowers was well known in that city, having been vice-president and general manager of the United Railways & Electric Company almost a decade ago. He gave up this executive position in 1923 to become president of the New Orleans Public Service Corporation, relinquishing the duties of this office about a year ago, when he removed to New York.

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ARTHUR E. SCOTT, 60 years old, director of public relations of the Central Illinois Public Service Company, who died in Springfield, Ill., was well known in Indianapolis. He was a resident of Indianapolis for many years and was public relations director for the Interstate Public Service Company. He left the company in 1929 for Springfield.

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GUSTAVUS GOEPPER, vice-president and a director of the Cambridge Electric Light Company, died at his home in Cambridge, Mass., last month. He had given to the company the longest service of any of its executives. Mr. Goepper, who was 87 years of age, was president emeritus of the East Cambridge Savings Bank at the time of his death.

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EDWARD AMES YOUNG, president of the Clinton (Iowa) Gas & Electric Company and Interstate Power Company prior to their sale to the present holding corporations, died November 13 at the home of his brother, Courtland H. Young, in Clinton. Mr. Young was the son of the late W. J. Young, pioneer lumberman, and had been identified with many of the Young commercial and utility interests. He was president of the Clinton National Bank and vice-president of the Clinton Savings Bank at the time of his death. He was 59 years of age.

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Financial and Statistical News

BUSINESS in isolated sections indicates a definite turn upward, but the process is painfully slow. Fear and lethargy continue to dominate. Adverse factors are magnified and used to excuse inactivity and lack of initiative. Failure to reach agreement on the railroad payroll is the current excuse, although figures involved are negligible in the nation's total buying power. Although long anticipated, dividend reductions are given as the explanation of daily new market bottoms as stocks drift aimlessly. Utility common stocks are close to the low point for the depression.

——THIS WEEK MARKS THE FIRST UTILITY SENIOR FINANCING of any volume since September. An eleven-million-dollar issue offered this week is among the first senior financing in any branch of industry since early fall.

——POWER AND LIGHT COMPANY BOND DEFAULTS DURING THE YEAR ended November 1 are virtually negligible, although the utility list in general has increased sharply.

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Power Consumption Shows Increase

CONSUMPTION OF ELECTRICITY by power customers in the 612 communities served by the Central and South West Utilities Company is running 8.1 per cent ahead of last year, according to figures announced recently by James C. Kennedy, president of the company. Output to power users in October, 1931, was 37,375,760 kw.-hr., against 34,554,510 kw.-hr. in October, 1930. Power sales represent approximately 60 per cent of total sales of energy.

Reasons for this gain, Mr. Kennedy said, are substantial increases in cotton ginning and oil field activities in the Southwest, as well as other gains noted by a widely diversified number of smaller industries served by subsidiaries of his company in Texas, Oklahoma, Arkansas and Louisiana.

Sales of energy to residential customers, which amount to approximately 10 per cent of total sales, also showed a gain of 6.1 per cent for October over October, 1930, while total sales for October increased 5 per cent over total sales for September, 1931.

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Big Increase in British Current Consumption

OFFICIAL RETURNS issued by the British Electricity Commissioners show that 1,035,000,000 kw.-hr. was generated by authorized undertakers in the United Kingdom during the month of October, 1931, as compared with the finally revised figure of 967,000,000 units in the corresponding month of 1930, or an increase of 7 per cent.

During the first ten months of 1931, to the end of October, the amount generated was 9,083,000,000 kw.-hr., as compared with 8,729,000,000 kw.-hr. for the corresponding period of 1930, representing an increase of 4 per cent.

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Weekly Output Rises

ENERGY OUTPUT of electric light and power plants continues somewhat less than in 1930, but rose materially last week. Beginning with the week ended October 24, it was below last year's corresponding output in successive weeks by 5.8, 5.1, 5.8 and 5.2 per cent, respectively. Last week it was down only 3.9 per cent.

Moderate gains compared with 1930 have of late been quite regularly reported from New England, but in other sections the output remains below last year's. In the central industrial area the deficiency has been ranging around 8 or 9 per cent; on the Atlantic and Pacific seaboards around 2 or 3 per cent.

Comparable weekly totals, as announced by the National Electric Light Association, are shown in the following table:

	1931	1930	1929	1928
October 17.....	1,656	1,729	1,790	1,665
October 24.....	1,647	1,747	1,824	1,678
October 31.....	1,652	1,741	1,816	1,688
November 7...	1,628	1,728	1,798	1,697
November 14...	1,623	1,713	1,794	1,696
November 21...	1,655	1,722	1,818	1,701

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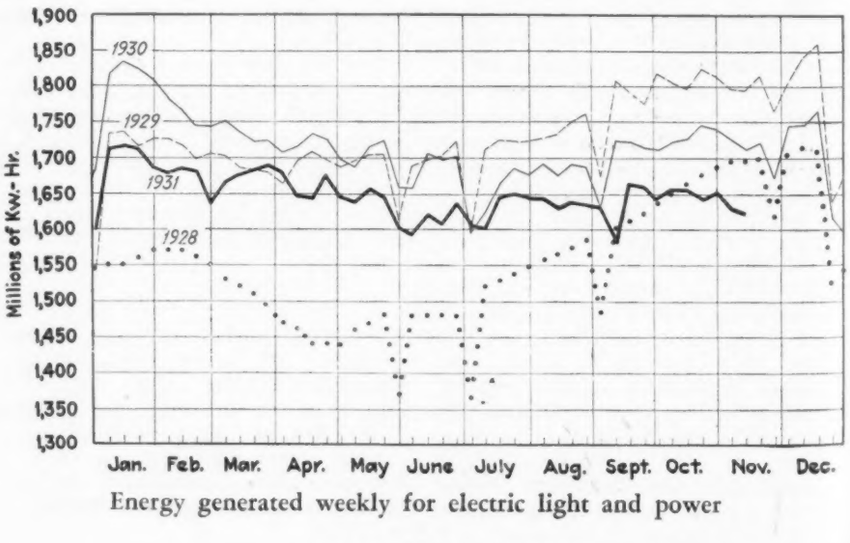
Colorado Utility Offers Bond Issue

OFFERING WAS MADE of a new issue of first mortgage and refunding 6 per cent bonds, series C, of the Public Service Company of Colorado during the week ended November 25, a piece of financing involving a total of $11,000,000. The bonds were priced at 91, to yield about 6.70 per cent. This financing marks the first public offering of mortgage bonds of the company in seven years.

The Public Service company, a subsidiary of the Cities Service Power & Light Company, reports net earnings before interest, depreciation and other charges for the twelve months ended September 30, 1931, of $7,217,827.

Another absentee from the market in recent years, Ohio Public Service Company, entered last week with an issue of



Energy generated weekly for electric light and power

first mortgage and refunding 5½ per cent bonds, series E, amounting to $3,434,000.

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Utility Bonds Added to Legal List in Massachusetts

The following additions to the list of public utility bonds legal for savings bank investment in Massachusetts have been announced:

Central Vermont Public Service Corporation
Rutland Railway, Light & Power Company, first 5s, 1946
Cleveland Electric Illuminating Company
general 5s, 1961
Empire Gas & Electric Company general and refunding 6s, 1952
Los Angeles Gas & Electric Corporation
first and general 5s, 1961
Metropolitan Edison Company
York Haven Water & Power Company first 5s, 1951
New York State Electric & Gas Corporation
New York State Gas & Elec. Corp. first 6s, 1952
Philadelphia Electric Company
Philadelphia Suburban Counties Gas & Electric Company first and refunding 4½s, 1957

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Swiss Energy Exports Bring $4,000,000 Yearly

UNLIKE SOME OF THE STATES in this country, Switzerland makes a business of selling electrical energy outside of her national borders. Apparently the only restriction is that permission must be granted by the proper governmental agency, which is charged with the duty of seeing to it that no energy is exported for which there is prospective need within the country during the term of the permit. Provision is also made for temporarily restricting exports in case of scarcity of water power.

The exported energy amounts to about 1,000,000,000 kw.-hr. and brings into the country a revenue of $4,000,000 annually, as is shown in the accompanying table, abstracted from official sources. The load factor is about 50 per cent and the average price, reckoning the Swiss franc at 19.3 cents, is about 4 mills per kilowatt-hour. During the hydraulic year 1929-1930 the exports constituted 24.4 per cent of all the energy produced for resale.

Swiss Energy Exports

Year	Millions of Kw.-Hr.	Revenue* Millions of Francs	Revenue* Centimes per Kw.-Hr.
1920	377	6.3	1.67
1921	328	6.7	2.04
1922	463	10.0	2.16
1923	522	12.7	2.44
1924	567	13.0	2.30
1925	654	13.6	2.08
1926	854	17.7	2.07
1927	961	20.3	2.11
1928	1,034	21.1	2.04
1929	990	20.6	2.08
1930	955	20.3	2.12

*1 franc = 100 centimes = 19.3 cents.

Vermont Commission Scores Loan to Holding Company

HOLDING that the Green Mountain Power Corporation, operating in Vermont, improperly loaned $688,087 to the People's Light & Power Corporation, its holding company, and that the transaction "had no relation whatever to furthering the corporate purposes of this Vermont operating company and runs counter to the basic principle of regulation of public utilities in order that the credit, bonds and stock, rates and service of these companies may be protected by the state in the interests of the people," the Public Service Commission of Vermont, in an order issued this week, not only refused to authorize the issuance of additional bonds by the Green Mountain corporation, but revoked its previous authorizations of issues aggregating $727,160.

All the common stock of the Green Mountain corporation, according to the order, is owned by the Peoples Light & Power Corporation, a subsidiary of the Tri-Utilities Corporation. Stating that the Vermont directors of the company knew nothing of the loan until several months later and that they "have worked loyally and efficiently for the petitioner," the commission added that "the pity of this situation is that their efforts have been seriously affected by the domination and exploitation of this operating company by their New York associates."

How this loan from the Green Mountain Power Corporation to the parent company was accomplished is thus summarized by the Public Service Commission:

On December 1, 1930, when the proceeds of the $1,500,000 notes were available, the New York directors, Gordon, McDaniel and Doetsch, Deal being absent from New York, decided without any formal directors' meeting or legal advice that Green Mountain should loan People's $660,367 on the unsecured demand note of the latter company. This was done without the consent of the bankers who negotiated the sale of the $1,500,000 notes on the representation of Green Mountain that the proceeds were required to raise funds for its 1931 construction budget and other corporate purposes.

At the same time a similar loan of $300,000 was negotiated by People's from another of its operating subsidiaries, Arizona Edison Company. The commission said:

We are given to understand that no effort was made properly to adjust this illegal loan from Green Mountain and that it was connived at by those directors of both companies who knew about it and that these representatives of the bankers on both boards knew nothing about it until some time in July or August of this year, when Mr. Jewell heard of it and made objection. It was then orally agreed that the common stock of the Arizona Edison Company should be held as security for this loan from Green Mountain, but, when this commission on October 29 last examined the balance sheet of the Arizona company, it was evident that this stock was worthless. On this last-mentioned date the commission issued its order denying its approval of the $322,000 bonds of petitioner, but publication of the order was delayed on request of Mr. Hill until the petitioner could be further heard. On November 5 Messrs. Deal, F. W. Peters, assistant treasurer and comptroller; Gleason, Hill and Glover Johnson, attorney representing the bankers above mentioned, appeared and urged that the action taken by the Green Mountain directors on November 4 accepting the note of the Texas Public Service Company for $619,514 to the People's and indorsed by People's to Green Mountain liquidated the debt of People's to Green Mountain and, therefore, changed the status of the situation so that this commission would be warranted in approving the $322,000 bonds.

Receivers were appointed last week for the People's Light & Power Corporation and Mid-West State Utilities on allegations of insolvency.

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Utility Offers Stock to Holders at Reduced Prices

ANNOUNCEMENT HAS BEEN MADE by Harry Reid, president of the National Electric Power Company, of a new offer of stock purchase warrants at reduced prices for certain classes of stockholders of the National Electric Power Company.

The reduction in price, Mr. Reid said, is being made in order to give shareholders an opportunity to purchase shares called for by their warrants on terms consistent with present changed conditions. Stockholders who previously exchanged warrants at higher prices will be refunded the difference between the original price and the present purchase price.

In a letter to the registered owners of National Electric Power Company 7 per cent preferred stock with class B common stock warrants attached Mr. Reid stated that the board of directors has voted to reduce the prices at which warrant holders may purchase class B common stock from $50 per share to $32.50 per share, provided the warrants

are exercised on or before December 31, 1931.

After that date the price at which the warrants may be exercised will be the same as provided in the warrants, namely, $60 per share to and including December 31, 1933, and $75 per share thereafter, to and including December 31, 1934. The class B common stock has been paying quarterly dividends regularly since 1927 at the rate of $1.80 per share per annum. This cash dividend represents a return of 5.53 per cent on the reduced purchase price of $32.50.

Each purchase is limited to one share of class B common for each share of 7 per cent preferred stock with warrant now owned. Owners will receive in return a new 7 per cent preferred stock certificate, without warrants, and a certificate covering shares of class B common purchased.

Similar proposals have been made in letters to stockholders of National Public Service Corporation, covering stock purchase warrants for the purchase of this affiliated company's class B common stock.

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Canadian Power Output Well Sustained

REVIEWING CONDITIONS in the electric appliance industry of Canada, D. C. Durland, president of the Canadian General Electric Company, Ltd., notes that the electrical output from Canadian power plants for the first six months of 1931 was less than 7½ per cent below that of the same period last year, and less than 3½ per cent below that of the year 1929.

In 1929 the total output was 17,632,876,000 kw.-hr. and in 1930 18,862,729,000 kw.-hr., an increase of about 1.3 per cent. From present indications, according to Mr. Durland, the total output and the total consumption of electricity by power, light and heat for the year 1931 will be only slightly less than the total for last year.

"This favorable condition," says Mr. Durland, "is due largely to the steady increase in the use of electric lighting and electrical appliances in the home. The annual increase in current consumption for domestic purposes is about 14 per cent. This largely counteracts the temporary falling off of power loads due to curtailed production in many of our manufacturing plants. The use of domestic electrical appliances has shown a remarkable growth in the last few years.

In Canada, at the beginning of this year, it is estimated that there were in use something like 84,000 electric refrigerators, 210,000 ranges, 1,260,000 irons, 800,000 radio sets, 350,000 vacuum cleaners, 560,000 toasters, 84,000 water heaters, 350,000 washing machines and 70,000 fans. These appliances alone consumed during 1930 a total of 908,080,000 kw.-hr., which, together with domestic lighting, contributed a revenue in excess of $37,000,000 to Canadian central stations."

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Plans Segregation of Power Properties

ALL water power properties of the International Paper Company in the United States will be transferred to the International Hydro-Electric System if stockholders' approval for such a policy is secured at a meeting December 5. These two companies are subsidiaries of the International Paper & Power company.

As an initial step, it is proposed that the directly owned properties, with minor exceptions, be transferred to subsidiary companies, all the stock of which will be controlled by International Paper Company. The company's interest in the properties will not be diminished by these transfers, but its ownership will be changed from a direct to an indirect one.

These transfers will facilitate the consummation of the paper company's announced policy of ultimately segregating all its power properties under the control of International Hydro-Electric System. It was in accordance with this policy that International Paper & Power Company was formed in 1928, and that International Hydro-Electric System was formed in 1929 and acquired from the paper company the shares of New England Power Association and of Canadian Hydro-Electric Corporation, Ltd., which the paper company then controlled.

The segregation of all these power properties under the control of the system would permit their more efficient and economical development and their more ready financing in a manner advantageous to both the paper company and the system. The acquisition of these properties, which would carry with them sufficient income in their present partially developed state to place them immediately on a self-supporting basis, would add approximately 450,000 hp. to the potential hydro-electric capacity of the system.

The more important powers are located in the heart of the northeastern superpower district and are within transmission distance of some of the largest industrial, commercial and residential markets in North America, including those served by the distribution properties of International Hydro-Electric System in New England. Through its holdings in the system, the paper company would retain a substantial interest in all these power properties. These holdings comprise all the class B stock and 30 per cent of the common stock of the system, the remaining 70 per cent of the common stock of the system being owned by International Paper & Power Company.

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Domestic Use 24 per Cent Over 1929

DOMESTIC USE OF ELECTRICAL ENERGY continues to increase; so does the use for commercial lighting and small power, as well as for municipal lighting. Every one of these items was larger during the first eight months of 1931 than in the same period of 1930; compared with 1929 the increase is even more pronounced; in the case of domestic service it is striking, for it amounts to nearly 24 per cent in two years. Response to reduced industrial activity appears in only one major item, wholesale power and light. Decreased use of energy for street and interurban railway operation must be ascribed, in part at least, to other causes.

These conclusions follow from statistics recently published by the National Electric Light Association and reproduced, somewhat abbreviated, in the accompanying table.

Energy Sales to Ultimate Consumers, First Eight Months

	Millions of Kw.-Hr.			Per Cent Increase	
	1931	1930	1929	1931/1930	1931/1929
Domestic services (all uses)	7,681	7,115	6,212	+7.9	+23.7
Commercial—Small light and power (retail)	9,208	9,095	8,456	+1.2	+8.9
Commercial—Large light and power (wholesale)	25,954	28,442	29,331	—8.7	—11.5
Municipal street lighting	1,467	1,400	1,272	+4.8	+15.3
Railroads—Street and interurban	3,114	3,256	3,358	—4.4	—7.3
Railroads—Electrified steam	395	387	401	+2.1	—1.5
Municipal and miscellaneous	308	328	275	—6.2	+12.0
Total sales to ultimate consumers	48,127	50,023	49,305	—3.8	—2.4

CURRENT EARNINGS REPORTS OF ELECTRIC LIGHT AND POWER COMPANIES

Operating Companies

	1931	1930	Per Cent Increase	Operating Ratio 1931	Operating Ratio 1930
Detroit Edison (Year ended October 31)					
Gross earnings	$50,070,921	$54,308,133	— 7.8	65	68
Net earnings	17,358,829	17,386,510	— 0.2	..	..
Gulf States Utilities (Year ended September 30)					
Gross earnings	6,528,690	7,106,762	— 8.1	57	55
Net earnings	2,762,570	3,172,430	—12.9	..	..
Louisville Gas & Electric (Year ended September 30)					
Gross earnings	10,871,578	10,510,318	3.4	..	..
Net earnings	5,957,725	5,359,851	11.1	..	..
Northern States Power (Year ended September 30)					
Gross earnings	33,956,954	33,160,054	2.4	..	..
Net earnings	17,343,893	16,752,440	3.5	..	..
Oklahoma Gas & Electric (Year ended September 30)					
Gross earnings	12,178,322	14,753,251	—17.5	..	..
Net earnings	5,784,339	6,962,367	—16.8	..	..
San Diego Consolidated Gas & Electric (Year ended September 30)					
Gross earnings	7,420,406	7,308,682	1.5	..	..
Net earnings	3,773,443	3,600,029	4.8	..	..
Southern California Edison (Ten. mos. ended October 31)					
Gross earnings	34,269,688	34,444,140	— 0.5	..	..
Net earnings	22,634,605	23,301,894	— 2.9	..	..
Virginia Electric & Power & subs. (Year ended September 30)					
Gross earnings	17,097,062	17,179,869	— 0.5	54	55
Net earnings	7,915,636	7,700,702	2.8	..	..
Wisconsin Public Service (Year ended September 30)					
Gross earnings	5,592,118	5,625,446	— 0.6	..	..
Net earnings	2,383,680	2,367,269	0.7	..	..

Holding Companies

	1931	1930	Per Cent Increase	Operating Ratio 1931	Operating Ratio 1930
American Light & Traction & subs.* (Year ended September 30)					
Gross earnings	$41,601,235	$45,780,069	— 9.1	72	72
Net earnings	11,485,555	12,882,499	—10.9	..	..
American Water Works & Electric & subs. (Year ended September 30)					
Gross earnings	51,293,833	54,905,671	— 6.6	52	50
Net earnings	24,775,060	27,278,118	— 9.2	..	..
Cities Service (Year ended October 31)					
Gross earnings	39,335,371	60,933,164	—35.3	..	..
Net earnings	36,959,692	58,656,589	—36.8	..	..
Federal Light & Traction & subs. (Year ended September 30)					
Gross earnings	8,190,969	8,524,383	— 3.9	55	54
Net earnings	3,702,180	3,895,232	— 5.0	..	..
North American Light & Power & subs. (Year ended September 30)					
Gross earnings	47,057,219	47,020,851	0.0	47	55
Net earnings	21,806,245	21,066,236	3.5	..	..
Philadelphia Company (Year ended September 30)					
Gross earnings	58,222,808	62,473,437	— 6.8	..	..
Net earnings	29,488,744	30,520,632	— 3.4	..	..
Public Service Corp. of New Jersey & subs.* (Year ended October 31)					
Gross earnings	138,364,373	139,014,356	— 0.5	67	69
Net earnings	45,705,979	43,149,346	5.9	..	..
Standard Gas & Electric & subs. (Year ended September 30)					
Gross earnings	148,662,594	155,104,001	— 4.1	50	52
Net earnings	73,059,960	74,455,034	— 6.8	..	..

* Operating expenses include depreciation.

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NEWS BRIEFS

Passing all previous marks, the Department of Water and Power of the City of Los Angeles earned net profits amounting to $4,344,289 in the past fiscal year, according to report filed yesterday. The figures represent an increase of $120,000 over those of any previous year. Before deductions for interest and depreciation charges, the net income totaled $7,811,684. The total revenues for the year represented an increase of $121,193, resulting from an increased sale of 13,335,861 kw.-hr., which in turn represents an increase of 2 per cent.

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The California Railroad Commission has extended until Dec. 31, 1931, the time in which Southern California Edison Company, Ltd., may issue and sell $6,600,000 face value of its refunding mortgage gold bonds, series of 4½'s, due 1955. The bonds were authorized by the Commission on Sept. 21, 1931.

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The Bank Commissioner of the State of New Hampshire has ruled that the following bonds of the Alabama Power Company are legal investments for savings banks in New Hampshire: first mortgage 5 per cent bonds, due March 1, 1946; first and refunding 4½ per cent bonds, due December 1, 1967; first and refunding 5 per cent bonds, due September 1, 1968; first mortgage lien and refunding 5 per cent bonds, due June 1, 1951 and first mortgage lien and refunding 5 per cent bonds, due November 1, 1956. These bonds are also legal investments for savings banks in New York, New Jersey, Maine and California.

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Directors of the Central States Edison Company recently paid a dividend of 75 cents per share on the 7 per cent cumulative preferred stock, par $100. Previously the company made regular quarterly payments of $1.75 per share on this issue.

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Directors of the Eastern States Power Corporation have voted to defer the quarterly dividends due November 1 on the $7 cumulative preferred stock, series A, and $6 cumulative preferred stock, series B, both of no-par value. On August 1 last the regular quarterly distributions of $1.75 per share on the $7 preferred and $1.50 per share on the $6 preferred stock were made.

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Less per Capita in European Cities

INTERESTING COMPARISONS of the use of electricity in the great cities of Europe with those of the United States have recently been made public by Dr.-Ing. Adolph, general manager of the Berlin (Germany) City Electric Company.

While many of the European cities show a high proportion of wired homes, the average amount of electricity used per consumer is usually far below the figure commonly met with in the United States. In addition to this, the increased electrification of industry in this country shows a total use, when reduced to per capita figures, much in excess of anything found abroad. The proportion of wired homes in various cities in 1927 is given by Dr. Adolph as follows:

City	Per Cent Wired
Basle, Switzerland	100
The Hague, Holland	100
Zurich, Switzerland	99.3
Amsterdam, Holland	96.0
Copenhagen, Denmark	89.8
Stockholm, Sweden	88.8
Stuttgart, Germany	82.4
Paris, France	63.8
Budapest, Hungary	56.6
Berlin, Germany, about	50.0
Chicago	96.3

The total annual sales of current for all purposes in these cities, when divided by the population, gives a good illustration of the extent of electrified industry and the degree to which the inhabitants are making use of electricity. As given by Dr. Adolph, the per capita sales of energy in various cities in 1927 were as follows:

	Kw.-Hr. per Capita
Basle, Switzerland	640
Zurich, Switzerland	604
Stockholm, Sweden	295
Paris, France	279
Stuttgart, Germany	258
Berlin, Germany	252
Amsterdam, Holland	236
Vienna, Austria	210
The Hague, Holland	209
Hamburg, Germany	209
Copenhagen, Denmark	195
London, England	151
Budapest, Hungary	135
Chicago	1,088
Philadelphia	914
Detroit	884
New York	667

Business News and Markets

Huge Refrigeration Drive

THE ELECTRIC REFRIGERATION BUREAU will carry on during 1932 "the greatest co-operative advertising and selling activity in the history of the electrical industry." This decision was approved by the executive committee of the bureau and the announcement was made by J. E. Davidson of the Nebraska Power Company, Omaha, national chairman of the bureau. The advertising budget calls for the expenditure of $412,000.

"Co-operative advertising and selling experience during the current year," Mr. Davidson states, "has proved that intensive advertising and selling can produce results in spite of the depressed state of business. At the beginning of our program this year our goal was 1,000,000 refrigerators — an ambitious program for these selling times. Reports from local co-operative bureaus already tabulated show that our co-operative advertising and selling has made the people of America 'food preservation conscious.' By the end of the Christmas selling activity we are confident that we will exceed our goal of 1,000,000 refrigerators sold during 1931." The national sales quota for 1932 will remain at 1,000,000 refrigerators. All-year-round refrigeration will be stressed.

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Power the Foundation of European Unity

ELECTRIC POWER WILL ultimately unify European countries. Existing plans for large-scale electrical interconnection are, indeed, the basis for a future United States of Europe. This is the belief of Dr. Carl von Siemens, chairman of the board of Siemens & Halske Aktiengesellschaft, who has just completed a short visit to America.

This interconnection, Dr. von Siemens states, represents the trend from political to economic and technical administration of the affairs of nations. "There is no doubt," he is quoted as saying, "that a beginning has been made to create a strong tie of economic interest and a visible proof of the actual interdependence of nations.

"Up to the present time," he said, "little has been done to materialize theories and ideas that tend toward establishing a United States of Europe, and it was left to the practical business men and engineers to create a highly efficient economic entity that will be the nucleus of further development in that direction.

"Only after the electrical engineer made possible the use of high-tension voltage in long-distance transmission lines could such a project take practical shape.

"Future generations will consider the interconnection of the various sources of electric power in the different European countries as a matter of course, but in this instance, a great many difficulties had to be overcome before the whole project could be carried out."

Electropneumatic Control for New York Subway

ELECTROPNEUMATIC control equipment costing $1,230,000 has been ordered by the Board of Transportation of New York City from the Westinghouse Electric & Manufacturing Company. This control apparatus will be used on the 500 new subway cars needed for the city's expanding rapid transit system which is a part of the billion dollar traffic and transportation program. The total cost of these cars with their equipment is more than $14,000,000.

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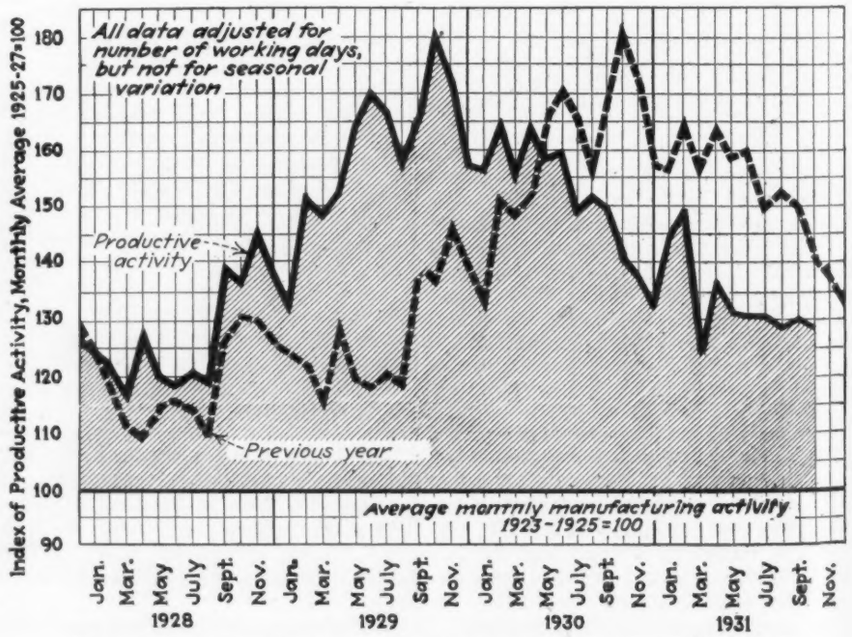
Steady Rate of Electrical Manufacturing

ELECTRICAL manufacturing activity has held steady within narrow limits during a full half year, according to statistics on electrical energy consumption received monthly by the ELECTRICAL WORLD. Indeed, if the dip and rise in March and April are considered as balancing, and as due possibly to a carry-over into April of one day's energy that should have been credited to March in the reports, then it may be said that there has been almost no change in eight months. This will be evident from the chart.

By contrast, it will be seen that there had been a pronounced and almost continuous decline from the peak in 1929 until the early part of the current year, when it came to an end.

Comparative Index Numbers

	1931	1930
October	128.5	140.6
September	129.8	150.0
August	128.0	152.2
July	130.1	148.5
June	130.8	160.2
Average ten months	133.4	154.9



Barometer of productive activity in the electrical manufacturing plants of the United States

Compared with 1930 the October index is down about 9 per cent; compared with 1929, 19 per cent. It is nearly the same as in October, 1926 and 1927, and higher than in any month of 1928 prior to September.

Similarity between September and October is found not only in the averages but in most of the individual returns, with possibly the suggestion of an upward turn in New England. Generally speaking, the rate of operation of most of the reporting companies shows comparatively little change.

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Pittsfield, not Pittsburgh

ACCOMPANYING A PHOTOGRAPH of vacuum oil-treating tanks for transformers, in the Pittsfield plant of the General Electric Company, used in the November 7 issue of the ELECTRICAL WORLD, the caption inadvertently read Pittsburgh, rather than Pittsfield.

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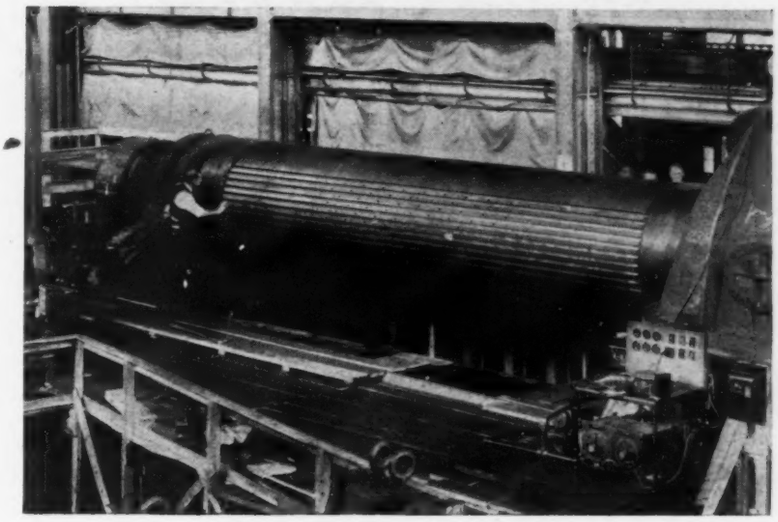
REVOLVING FIELD PRODUCING 160,000 KW.



Testing the revolving field for one of the two 160,000-kw. turbo-generators for the Brooklyn Edison Company at the Schenectady plant of the General Electric Company. It is claimed to be the largest 1,800-r.p.m. revolving field ever built as to size and capacity.

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TRADE BRIEFS

Thayer Field has been appointed secretary, treasurer and director of Hardwick, Hindle, Inc., Newark, N. J., to succeed John C. Hindle, resigned. Mr. Field was one of the original organizers of the company six years ago. The firm will continue under the name of Hardwick, Hindle, Inc. They are engaged in the manufacture and sale of resistance devices for electrical control purposes.

•

Wagner Peterson Corporation, Portland, Ore., has been appointed to represent the Meter Devices Company in the states of Washington and Oregon.

•

Dana Harland will direct the sales of the new "AE" fuse announced by the Associated Engineers Company of Chicago.

•

Driver-Harris Company was awarded first prize for no-lost-time accident by the National Safety Congress.

•

H. S. Sleicher is now associated with the General Refractories Company with headquarters in New York.

•

H. W. and J. G. Kilkenny will represent, in the Cleveland district, the Central Tube Company of Pittsburgh, the W. N. Matthews Corporation of St. Louis and the Moloney Transformer Company of St. Louis.

•

After November 30 the offices of the Metropolitan Electrical League of Boston will be located on the seventh floor of the new Boston Edison building at 182 Tremont Street, Boston, Mass. The present address is 158 Summer Street, and Edward G. Jay is manager, Jerald F. Davis being president.

•

E. H. Wilcox has been appointed manager of the export division of the Kelvinator Corporation.

•

Anaconda Wire & Cable Company announces the appointment of F. W. Brower as manager of rubber wire sales and H. N. Otis, sales promotion manager.

•

Foster Wheeler Corporation announces the opening of a branch office in Washington, D. C., under J. S. Malseed. It will be equipped to handle inquiries for stationary and marine power plant equipment.

Power Plant for West Point

EQUIPMENT FOR A complete new power plant for the United States Military Academy at West Point, N. Y., has been ordered from the Westinghouse Electric & Manufacturing Company. This equipment includes two 1,000-kw., non-condensing turbo-generators and a switchboard for the control of these machines and for the distribution of the power generated.

The plant now in service at the academy generates direct current, a small portion of which is converted to alternating current. The apparatus ordered for the new plant will provide a changeover to alternating current, except for a small portion of direct current that is absolutely essential.

An interesting feature of the new power plant will be the inexpensive generation of by-product power from steam used for building heating.

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DELINQUENT ELECTRICAL ACCOUNTS

(National Electrical Credit Association)

Number of Accounts Reported

Division	October 1930	October 1931	Per Cent Inc. or Dec.	Ten Months 1930	Ten Months 1931	Per Cent Inc. or Dec.
New York	258	263	+ 1.9	2,877	2,409	—16.2
Middle & Southern Atlantic	114	87	—23.6	1,573	1,166	—25.8
New England	89	79	—11.2	1,171	920	—21.4
Central	640	551	—12.8	7,200	5,603	—22.2
Total	1,101	987	—10.3	12,821	10,098	—21.2

Total Amounts Reported

	October 1930	October 1931	Per Cent Inc. or Dec.	Ten Months 1930	Ten Months 1931	Per Cent Inc. or Dec.
New York	$32,447	$35,514	+ 9.4	$448,629	$311,829	—30.5
Middle & Southern Atlantic	18,419	9,627	—47.7	243,935	146,663	—39.8
New England	8,445	4,779	—43.4	153,346	79,625	—48.0
Central	62,839	45,494	—27.6	919,461	503,955	—45.2
Total	$122,150	$95,414	—21.8	$1,765,371	$1,042,072	—40.9

Market Conditions

LARGE-SCALE construction on the Pacific Coast continues almost at a standstill. Stocks of equipment on hand are so low, however, that any material trade impetus would speed up buying on a large scale. Day-to-day buying on the part of utilities and industry is sharply reduced both here and in the Middle West.

——BUYING CONTINUES TO EASE OFF IN THE EASTERN DISTRICT and commitments are falling considerable below estimated averages. Both power company and industrial inquiries are sharply limited. Holiday business so far is unusually disappointing.

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EASTERN

—BUYING CONTINUES TO EASE OFF *in the electrical equipment market in the Eastern district, and despite an improved tone and sentiment the fact remains that commitments are falling considerably below estimated averages. Inquiries from power companies have trended downward during the past few weeks, while industrial demand shows betterment in volume call, with orders, however, rather severely limited.*

—THE REDUCED CALL *for electrical specialties for holiday account is a distinct disappointment to that branch of trade. It is currently estimated that sales of appliances, usually in heavy demand at this time, show a decline of 25 to 30 per cent as compared with this time a year ago. Both manufacturers and jobbers say that there is little encouragement in sight.*

Five bidders have tendered figures for a generating set for the United States Engineer Office at Buffalo, N. Y., with low quotation from the Electric Boat Company at $52,665. A New York manufacturer has secured an award for switchgear, transformers and accessory equipment from a state power company, aggregating $130,000. Westinghouse Electric & Manufactring Company will furnish stoker equipment for a power installation in a state hospital in Massachusetts. Newport News Shipbuilding & Dry Dock, New York, has secured an order for hydraulic equipment from the city of Los Angeles, Calif., at $74,305, while General Electric Company will furnish transformers and accessories at $42,985.

The Fonda Johnstown & Gloversville Railroad Company has placed a contract with the J. G. Brill Company for five high-speed electric motor cars for its line between Gloversville and Schenectady, N. Y., at a total cost approximating $125,000. Cars will be practically all-aluminum construction and will use 450-hp. motor units. The railroad company has placed orders for a quantity of electrical apparatus for substation and other work. Westinghouse Electric & Manufacturing Company has taken orders for electric lighting equipment for textile mills in the South, including plants in Georgia and Alabama.

With from 60 to 70 per cent of holiday purchases now made, electric appliance sales to jobbers and retailers are of a sluggish character. Coffee percolators, toasters, irons, small heaters and kindred specialties are having a lean season, and even lower price levels are not sufficient to attract prospective buyers. Electric refrigerators, however, continue to secure satisfactory attention and it is currently expected that gross commitments will equal, if not exceed, those of last year. General Electric Company is running on a high production schedule for electric refrigerator manufacture at its Erie, Pa., plant, where work is nearing completion on a new addition representing a cost of more than $200,000; electric railway equipment, likewise, is produced at this works.

CONSTRUCTION PROJECTS

Constructing Quartermaster, Mitchel Field, N. Y., will receive bids until December 3 for an electric distributing system (Circular 10). Buffalo, Rochester & Pittsburgh Railroad Company, Rochester, N. Y., plans engine house with shop facilities at Buffalo, N. Y., to cost about $45,000. Utica Gas & Electric Company, Utica, N. Y., plans extensions and improvements in hydroelectric power plant at Trenton Falls, N. Y., to increase capacity. Commissioner of Correction, Albany, N. Y., will receive bids until December 3 for an electric generator for the Thomas Indian School at Iroquois, N. Y. Public Service Electric & Gas Company, Newark, N. J., will soon begin the superstructure for a power substation at Irvington, N. J., to cost $115,000. Pennsylvania Railroad Company, Philadelphia, Pa., made application for permission to construct a 132,000-volt transmission line across Frankford Creek at junction with Delaware River. United States Engineer Office, Pittsburgh, Pa., is asking bids (no closing date stated) for power house at Lock No. 4, Monongahela River.

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SOUTHEAST

—A QUIET WEEK *was registered in the Southeast, but the general volume of business is reasonably well sustained.*

One of the larger companies in the section let a number of orders, its transformer purchases amounting to $11,800. Creosoted pine poles and pole line materials totaling $9,800, wire and cable aggregating $7,650 and voltage regulators costing about $6,000 were also ordered by the same company. A Louisiana company ordered $2,000 worth of meters and a Georgia company ordered similar equipment to the extent of $2,500. Lighting materials amounting to $3,000 were ordered for a southern Florida airport and an industrial in the same state purchased a turbine costing approximately $1,500. A Tennessee telephone company ordered $5,250 lb. of bare copper wire.

CONSTRUCTION PROJECTS

Constructing Quartermaster, Langley Field, Va., will receive bids until December 2 for an electric distributing system (Circular 21). Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until December 1 for air compressors, etc., for navy yard at Norfolk, Va. (Schedule 6950). City Council, Augusta, Ga., authorized bond issue of $2,500,000 for construction of steam-operated and hydro-electric generating plants, and transmission lines.

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MIDDLE WEST

—GENERAL BUSINESS *in the Middle West section continues this week to mark time. While the volume of business remains fairly constant, there is very little encouragement to be derived from any activities, either from the major industries or the utilities.*

A general feeling of inertia is appearing and the failure of certain important conferences for production stabilization, together with the apparent weakness of the security markets, is having a somewhat depressing effect on general business. Very little is expected from railroad sources. Industrial activity is unusually spotty; employment is not increasing, and the best that can be expected is that business will continue to drift along until the

close of the month at the present rate of activity. Wholesale and retail trade is uneven, with little seasonal activity.

While some encouragement may be taken from the increase in production of electricity, the output is still materially below previous months in the year. The various utility companies have slowed up considerably on construction work, and while quite a bit of apparatus is on inquiry, the amount is small when compared with other years.

CONSTRUCTION PROJECTS

School Board, Racine, Wis., contemplates junior high school to cost over $450,000. Kewaunee, Wis., plans extensions and improvements in electric lighting plant and will arrange bond issue. School Board, Battle Creek, Mich., plans auditorium and high school to cost $500,000. Treasury Department, Washington, D. C., asking bids until December 9 for post office building at Maywood, Ill., to cost $160,000. Northern States Power Company, Sioux Falls, S. D., plans construction of transmission lines at Crooks, S. D., and vicinity. Iowa Railway & Light Company, Cedar Rapids, Iowa, contemplates power substation and line extensions at Mechanicsville, Iowa.

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SOUTHWEST

—THE NEAR APPROACH *of the Christmas holidays has toned up selling conditions as to electrical appliances for use in the home.*

—ARTICLES SOLD *by specialty men, including washing machines, ironers, stoves ,refrigerators and radios, have been holding up fairly well. On the other hand, over-the-counter sales of smaller household items, such as toasters, heaters, waffle irons, lamps, etc., have not been doing so well, but should be helped by the gift season.*

It is generally conceded that the volume of Christmas sales this year probably will be well below the average for the past five years. In the industrial and utility fields confidence has apparently been restored and prospects are brightening. An order for about $8,000 worth of motors and transformers has been placed by a general contractor for a construction job. Some other orders of fair proportion are about ready to be signed.

CONSTRUCTION PROJECTS

United States Department of Commerce, Aeronautics Bureau, Washington, D. C., plans radio station for airway service at Springfield, Mo., to cost $80,000. State Department of Public Affairs, Oklahoma City, Okla., plans penitentiary at Atoka, Okla., to cost $420,000. Treasury Department, Washington, D. C., is having plans completed for a post office and court house at Beaumont, Tex., to cost $495,000.

PACIFIC COAST

—PRESENT CESSATION *of the majority of large and even medium-sized building construction is reflected in the San Francisco record for October, showing a 40 per cent decline in value over last year, but only a 10 per cent decrease in the number of permits.*

—WHOLESALE ELECTRICAL SALES *for the year have decreased about 33⅓ per cent in value for the Pacific Coast, or perhaps about 20 per cent in volume, if lower prices are allowed for. Collections are still very fair, but failures or attachments have lately been hitting a rather larger type of retailer.*

Stocks of schedule material are so low that any stort of trade impetus would give a disproportionate volume of buying. Power company purchasing, for instance, is running about one car of pole line hardware per week for central California, compared with a normal two- or three-car rate. A recent three-carload purchase of 10-ft. stubs for this area indicates a temporary desire to maintain rather than reconstruct. Power machinery purchasing however, is running high in special material, such as three 2,000-kva. Moloney transformers, valued at 25,000 for the Hetch-Hetchy coast range tunnel, three 36-kva. General Electric regulators for the Modesto irrigation district and a 17,500-kva. Allis-Chalmers waterwheel generator for the San Francisquito new unit in southern California.

Manufacturers report increased volume in sizes 5- to 500-kva. distribution transformers for this area, though they do not expect a corresponding call for the northern area until 1932. Los Angeles is in the market for two 600-amp., 110,000-volt circuit breakers, while an entire steam plant totaling $1,000,000 will probably be bought in San Francisco by December 1. Construction will begin in the early Spring on temporary and permanent power lines for a metropolitan water area in southern California, requiring ten carloads each of high-tension insulators and line hardware, while 11 miles of construction railway at the Hoover dam site is to be immediately electrified.

Although a considerable number of inquiries for electrical apparatus and motors were reported received by jobbers in the Seattle district last week sales showed no improvement, the volume being a thrifle less for the period than in any other week of the month. One of the largest jobbers reported the sale of 30 motors from 25 hp. down to scattered industrial sources, twenty distribution transformers from 50 kva. down and two $1,200 feeder regulators. The city of Tacoma opened bids for 35,000 lb. of No. 0000 A.G. weatherproof insulated copper wire solid, the city of Seattle bought 10,000 lb. of 250,000-circ.mil soft-drawn stranded copper wire and the Puget Sound navy yard at Bremerton bought 3,000 ft. of pipe conduit. Work on the Prosser, Wash., power dam and power canal, for which the United States government has appropriated $640,000, will start about January 1, is understood.

CONSTRUCTION PROJECTS

Pacific Gas & Electric Company, San Francisco, Calif., plans extensions and improvements in power substation and transmission lines at Lodi, Calif., and vicinity, to cost over $200,000. Atchison, Topeka & Santa Fe Railroad Company, Los Angeles, Calif., will build power plant at shops at Needles, Calif., to cost about $75,000. California Institute of Technology, Pasadena, Calif., has plans for new units for chemistry and biological buildings, estimated cost, $600,000. Sacramento, Calif., plans installation of electric pumping machinery for water project to develop capacity of 90,000,000 gal. daily. Jackson County Supervisors, Medford, Ore., have approved plans for court house to cost $250,000.

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NEW ENGLAND

—BUYING OF SMALL *power equipment, including motors and control equipment, features the trend in the electrical market in this district and is confined in a considerable degree to small lots.*

—ORDERS FOR *heavy electrical machinery have fallen off and the likelihood for purchases is small in view of curtailments in force.*

Central-station supply buying has ceased, according to one manufacturer, except for a few emergency requirements and occasional insulators and switches in single lots. On the other hand, some betterment is noted in street-lighting activities as negotiations and inquiries are underway for extensions, including interest in the possibility of installations on the state trunk highways. Extension of electric traffic signals and the purchase of automatic signals is ordered for a prominent Boston thoroughfare costing over $30,000.

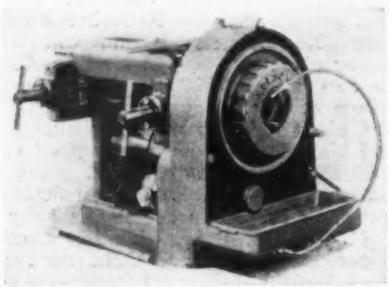
CONSTRUCTION PROJECTS

School Board, Cambridge, Mass., will take bids for addition to Rindge Technical High School to cost $1,500,000. National Biscuit Company, New York, plans plant at Cambridge, Mass., to cost over $150,000. Board of Contract and Supply, Hartford, Conn., will receive bids until December 7 for a portable air compressor.

New Equipment Available

Automatic-Feed Portable Pipe Threader

AN IMPROVEMENT IN DESIGN and construction of the portable pipe threader is announced by the Axelson Manufacturing Company, Los Angeles, Cal. This compact, sturdy machine consumes little power and operates rapidly, it is claimed. It can be attached to any standard light socket, is powered by a



General Electric Universal reversible motor and may be used on any 100-volt circuit. The threader will handle pipe in all sizes from ½ to 2 in. Bolt-threading dies may also be used, although they are not furnished as standard equipment.

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Automatic Combustion Flue-Gas Indicator

AN AUTOMATIC COMBUSTION INDICATOR designed to provide continuous indications of CO_2 only, CO_2 and furnace draft, CO_2 furnace and uptake draft and CO_2 furnace and flue-gas temperature is announced by the Hays Corporation, Michigan City, Ind.

Employing the Orsat principle of operation, the Hays CO_2 indicator is similar in design to the Hays CO_2 recorders. The power unit for the draft attachment is the Hays colon leather mechanism. The flue-gas temperature indicator is an instrument operating on the thermo-electric principle.

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10,000-Ohm Circuit Tester

AN INSTRUMENT CONSISTING of a small high-grade d'Arsonval type d.c. voltmeter connected in series with a small dry cell, known as the type HTD 10,000-ohm circuit tester, has been announced by the Roller-Smith Company, New York. The instrument pointer will indicate full scale when the terminals are short-circuited.

The uses of the circuit tester are twofold; it can be used to ascertain if there is an electrical circuit existing between conductors applied to the terminals of the instrument and, secondly, it enables the user to read the resistance of the circuit under test. The instrument is recommended for use by wiremen, repair men and for coil and other electrical work which necessitates identification and checking. It may be carried in the pocket and can conveniently be used when working on ladders or in places difficult of access.

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Single-Pass Oil Reclaimer

A COMPACT AUTOMATIC OIL RECLAIMER which it is claimed accomplishes full restoration of dielectric properties to serviced transformer oil, known as the "Uni-Pass" oil reclaimer, is announced by S. F. Bowser & Company, Inc., Fort Wayne, Ind. It is adaptable to the reclamation of circuit breaker oils for the removal of water and gases resulting from arcing, and carbon. It is also adapted for use in removing gases and moisture from oil used in oil-filled cables.

A few of the advantages claimed are: It renders oil anhydrous, of high dielectric strength, in a single pass; renders oil free, reduces the organic acid content of the serviced oil, filters the oil through an all-metallic filter and reduces the soluble and non-soluble sludges in the oil. It also enables passing extremely wet and dirty oil through the system just once fully to restore dielectric strength and color, and thoroughly dries and completely purifies oils, raising their dielectric strength well beyond the requirements of standard specifications, in less time and at less expense.

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Multiple-Duct, Socket-Joint Clay Conduit

A CONDUIT FOR UNDERGROUND electric light and power distribution known as "Natco" multiple-duct socket-joint clay conduit has been announced by the National Fireproofing Corporation, Pittsburgh, Pa. The new tapered socket joint makes centering and alignment positive and automatic, speeds up installation, utilizes unskilled labor and reduces laying costs. Furthermore, the joint may be readily sealed or cemented if additional tightness is desired. Smoothly rounded edges at the duct ends of this conduit make cable pulling safe and easy.

Individual ducts in every unit are self-spaced, yet permanently held together by links of vitrified clay. The design of this new conduit also provides an extra duct, centrally located, which may be utilized for small wires or cables, or merely for cable heat dissipation. This extra duct space displaces just that much concrete or mortar with a saving in weight and cost.

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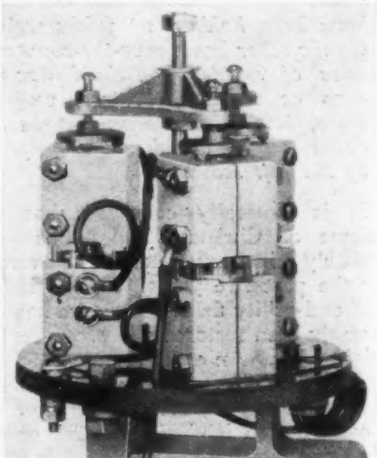
Power Line Communication Circuit Protector

A TELEPHONE PROTECTOR, known as "Serjdetour," developed by the Southern California Edison Company for communication circuits exposed to power lines, is being manufactured and marketed by the Reliable Electric Company of Chicago. It consists of three air gap units; one is connected from each side of the line to the ground and the third is bridged across the line.

More current is necessary to melt and so short circuit these gaps than to blow 25-amp. fuses. The "Serjdetour" protector used with fuses of this capacity will thus take care of most inductive disturbances without involving the blowing of a fuse; the telephone line is left clear as soon as the power line switches have opened.

The "Serjdetour" will sustain voltages of 66 kv. or more without blowing up and without allowing any of the high



voltage to get past it to damage the station telephone equipment, it is claimed. The discharge of such voltages through the "Serjdetour" usually involves a current of several thousand amperes, which will melt the "Serjdetour" electrode faces by its terrific heat action, the manufacturer states. It is a matter of only a few minutes, however, to repair this damage by replacing the electrodes.